COMPARATIVE OSTEOLOGY AND PHYLOGENY OF THE FAMILY ARDEIDAE

By

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INTRODUCTION

The Ardeidae, or herons, form one of the two families of birds comprised in the suborder Ardeae, order Ciconiiformes. The only other family referred to this suborder is Cochleariidae, the boat-billed herons. Five additional families are included in other suborders of the order Ciconiiformes (Peters, 1931). These are Balaenicipitidae, Scopidae, Ciconiidae, Threskiornithidae, and Phoenicopteridae. The family Ardeidae is cosmopolitan in its distribution, but the ranges of the other families are considerably restricted.

The earliest fossil records for the family are from the Eocene, although relatively few remains are known (Lambrecht, 1933). Earliest records in North America are likewise from the Eocene. They are Eoceornis ardetta Shufeldt and Botauroides parvus Shufeldt, both from the Bridger formation of Wyoming. Eoceornis ardetta, described from the anterior portion of the sternum, is a relatively small bird approximately the size of our modern Hydranassa or Leucophoyx. Botauroides parvus, described from a fragmentary tarsometatarsus, is considerably smaller than Ixobrychus, and is said to be neither typical heron nor true bittern. Because of its intermediate position it has been referred to as a stem form of the modern herons.

The latest revisor of the family Ardeidae divides it into two subfamilies, Ardeinae, the true herons, and Botaurinae, the bitterns (Peters, 1931). To these two subfamilies are referred thirty-one genera and sixty-two species. No less than eighteen of the genera are monotypic with the average number of species per genus for the entire family being only 2.0. Ardea is the largest genus with ten species.

The high proportion of monotypic or small genera does little to express interrelationships of the forms. Under the present system the genera have been set up entirely on the basis of external characters, and in many cases on such ephemeral characters as the seasonal breeding plumes. As the internal morphology of the family has never been investigated at the generic or specific level, it seemed probable that a study of the skeleton might yield information of value in determining intraspecific relationships and in defining the generic limits.

Cochlearius, the boat-billed heron, has been included in this study because of its taxonomic position in the order Ciconiiformes. This monotypic genus is currently assigned to the family Cochleariidae, the second family of the suborder Ardeae.

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MATERIALS AND METHODS

A total of 326 skeletons were used in this study. These were borrowed from museums and individuals, obtained through the medium of exchange, or collected by the writer locally. Of the thirty-one genera and sixty-two species currently assigned to the family, the following twenty-one genera and forty-two species were examined:

Ardea sumatrana Raffles, *Ardea goliath* Cretzschmar, *Ardea melanocephala* Vigors and Children, *Ardea cinerea* Linne, *Ardea herodias treganzai* Court, *Ardea herodias herodias* Linne, *Ardea occidentalis* Audubon, *Ardea cocoi* Linne, *Ardea pacifica* Latham, *Ardea purpurea* Linne, *Pilherodius pileatus* (Boddaert), *Butorides virescens virescens* Linne, *Butorides striatus atricapillus* (Afzelius), *Erythocnus rufiventris* (Sundevall), *Florida caerulea* (Linne), *Ardeola ralloides* (Scopoli), *Ardeola bacchus* (Bonaparte), *Ardeola speciosa* (Horsfield), *Bubulcus ibis ibis* (Linne), *Dichromanassa rufescens rufescens* (Gmelin), *Casmerodius albus modestus* (J. E. Gray), *Casmerodius albus egretta* (Gmelin), *Egretta garzetta garzetta* (Linne), *Egretta intermedia* Deignan, *Leucophoyx thula thula* (Molina), *Hydranassa tricolor ruficollis* (Gosse), *Syrigma sibilatrix* (Temminck), *Nycticorax nycticorax nycticorax* (Linne), *Nycticorax nycticorax hoactli* (Gmelin), *Nycticorax caledonicus caledonicus* (Gmelin), *Nyctanassa violacea violacea* (Linne), *Nyctanassa violacea bancrofti* Huey, *Gorsachius melanolophus* (Raffles), *Tigriornis leucolopha* (Jardine), *Tigrisoma lineatum lineatum* (Boddaert), *Tigrisoma mexicana mexicana* Swainson, *Ixobrychus sinensis sinensis* (Gmelin), *Ixobrychus involucris* (Vieillot), *Ixobrychus exilis exilis* (Gmelin), *Ixobrychus cinnamomeus* (Gmelin), *Ixobrychus strumii*

(Wagler), Botaurus stellaris stellaris (Linne), Botaurus lentiginosus (Montagu), and Cochlearius cochlearius cochlearius (Linne) of the family Cochleariidae.

Measurements. Eighteen measurements were taken on each specimen. All measurements, except those of the preorbital and postorbital, represent the overall lengths of their respective elements. The preorbital and postorbital measurements represent the width of that particular region of the skull. The descriptions of the measurements are given in Adams (1952), Baumel (1953), and Glatfelter (1950). Osteological terminology is that of Howard (1929).

A review of the standard measurements of size as given in Table 1 shows the impracticality of basing a taxonomic or phylogenetic study on these measurements because of the great variation in size of the species currently assigned to the family. It was decided therefore, that ratios would be used, rather than size, as the basis for the comparative study.

Ratios. Twenty-six ratios were computed from the eighteen skeletal measurements. Each is listed with its mean, standard deviation, coefficient of variation, and their respective standard errors in Table 2.

These ratios are divided into three groups, (1) those dealing with the skull, (2) the intramembral ratios, and (3) the intermembral ratios. Those of the skull were used to indicate differences in cranial development and culmen relationships. Intramembral ratios compare one element of the wing or leg with the remaining elements of the respective appendage. The ula and tibia were used as standards for the wing and leg ratios, respectively. Intermembral ratios compare elements of the wing to elements of the leg.

The intermembral and intramembral ratios were computed to show differences in structural modifications that might be correlated with the life history of a given species. Also these ratios might be correlated with the pattern of flight of some of the species. Through these two factors, these data may eventually be correlated with the ecology of the individual in some future study of the family.

Qualitative considerations. Certain qualities of contour and conformation, while measureable, do not lend themselves readily to such treatment. These characters have previously been referred to as perceptible differences by Fehon (1952), and as morphological differences by Nelson (1954). The works of these two men represent the extremes of methods of osteological study. Fehon's method was gross, compared to Nelson's method which was by the use of a stereoscopic microscope. Both methods have been useful in this study. The stereoscopic microscope was found to be most useful when gross examination proved inadequate.

Beecher (1953) expressed serious doubt as to the taxonomic value of osteological characters. However, I hold with Nelson (1954), that muscle scars and bony projections are, "....in certain cases, very important taxonomic characters."

The qualitative characters used in this study deal with just such projections and muscle scars as those referred to by Beecher, and Nelson. Some are of a very delicate nature, and others are more durable. The qualitative characters of the skull are delicate and difficult to preserve. I have attempted to eliminate characters that were not consistent in large series of specimens.

The elements of the post-cranial skeleton show profound qualitative differences. These characters afford sufficient evidence for grouping the species as presented in the following section, and when combined with the quantitative comparisons, they afford the basis for setting up the generic diagnoses. These qualitative characters are given in Plate 2 for ready reference.

QUANTITATIVE CHARACTERS

A review of the coefficients of variation of the skeletal measurements shows a relatively low value, the range being 0.85 per cent for the ulna (♂) of Ixobrychus exilis, and the quadrate width (♂) of *Tigrisoma mexicana* to 12.32 per cent for digit II, phalanx 1 (♂) of *Ardea purpurea*. The mean coefficient of variation is 3.85 per cent, which is a relatively low value as compared with similar statistics of other groups of animals.

The twenty-six ratios were originally calculated on the basis of sex. The sexes were then compared by a review of the ranges and means of the respective ratios. These comparisons showed that the sexes were inseparable because there was complete or partial overlap of the ranges, and frequently identical means. As a result, the sexes were grouped to give larger samples of rare forms.

A review of the coefficients of variation of the ratios shows a pattern similar to that of the skeletal measurements. The coefficients of variation range from 0.31 per cent for the radius/ulna ratio of *Bubulcus ibis* to 12.84 per cent for the preorbital/postorbital ratio of *Ardea herodias treganzai*. The mean coefficient of variation is 3.25 per cent, approximately the same as that of the raw skeletal measurements.

Following are the ratios used with their respective abbreviations:

Skull:	Ratio	Abbreviation
	Preorbital width/Skull length	Pre/Sk
	Preorbital width/Postorbital width	Pre/Post
	Preorbital width/Cranium length	Pre/Cr
	Postorbital width/Cranium length	Post/Cr
	Pterygoid length/Quadrate length	Pt/Ql
	Quadrate width/Quadrate length	Qw/Ql

Intramembral:	Abbreviation
Humerus/Ulna	Hu/Ul
Radius/Ulna	Ra/Ul
Carpometacarpus/Ulna	Cmc/Ul
Digit II, Phalanx 1/Ulna	P-1/Ul
Digit II, Phalanx 2/Ulna	P-2/Ul
Femur/Tibiotarsus	Fe/Ti
Tarsometatarsus/Tibiotarsus	Ta/Ti
Hallux/Tibiotarsus	Ha/Ti
Intermembral:	
Femur/Humerus	Fe/Hu
Femur/Ulna	Fe/Ul
Femur/Carpometacarpus	Fe/Cmc
Tibiotarsus/Humerus	Ti/Hu
Tibiotarsus/Ulna	Ti/Ul
Tibiotarsus/Carpometacarpus	Ti/Cmc
Tarsometatarsus/Humerus	Ta/Hu
Tarsometatarsus/Ulna	Ta/Ul
Tarsometatarsus/Carpometacarpus	Ta/Cmc
Hallux/Humerus	Ha/Hu
Hallux/Ulna	Ha/Ul
Hallux/Carpometacarpus	Ha/Cmc

In order to determine the similarity in trend of the ratios presented in Table 2, the species were assigned numerical rank, based on the ascending value of a particular ratio. Thus, in considering the ratio Preorbital width/Skull length, *Casmerodius albus*, with a mean ratio of 8.43 per cent, occupies position 1 and *Cochlearius cochlearius*, with a mean ratio of 16.75 per cent, occupies position 40. This indicates as far as this particular ratio is concerned, these two species are the most distantly removed from each other. On the other hand, *Ardea occidentalis* (mean ratio 9.50 per cent) and *Ardea herodias* (mean ratio 9.64 per cent) occupy positions 6 and 7, reflecting their close relationship.

Skull ratios:

Preorbital/Skull

1. *Casmerodius albus*
2. *Ardea purpurea*
3. *Hydranassa tricolor*
4. *Ardea sumatrana*
5. *Tigrisoma mexicana*
6. *Ardea occidentalis*
7. *Ardea herodias*
8. *Egretta garzetta*
9. *Dichromanassa rufescens*
10. *Leucophoyx thula*
11. *Ixobrychus involucris*
12. *Pilherodius pileatus*
13. *Tigrisoma lineatum*
14. *Floridana caerulea*
15. *Ixobrychus strumii*
16. *Tigriornis leucolopha*
17. *Ardea goliath*
18. *Butorides striatus*
19. *Ardea cinerea*
20. *Ardea cocoi*
21. *Ardeola ralloides*
22. *Egretta intermedia*
23. *Ixobrychus exilis*
24. *Ardea melanocephala*
25. *Ardea pacifica*
26. *Ardeola speciosa*
27. *Bubulcus ibis*
28. *Syrigma sibilatrix*
29. *Butorides virescens*
30. *Erythocnus rufiventris*
31. *Botaurus lentiginosus*
32. *Ardeola bacchus*
33. *Nycticorax caledonicus*
34. *Ixobrychus sinensis*
35. *Nyctanassa violacea*
36. *Nycticorax nycticorax*
37. *Botaurus stellaris*
38. *Gorsachius melanolophus*
39. *Ixobrychus cinnamomeus*
40. *Cochlearius cochlearius*

Preorbital/Postorbital:

1. *Gorsachius melanolophus*
2. *Nycticorax caledonicus*
3. *Nyctanassa violacea*
4. *Bubulcus ibis*
5. *Syrigma sibilatrix*
6. *Nycticorax nycticorax*
7. *Florida caerulea*
8. *Tigrisoma mexicana*
9. *Pilherodius pileatus*
10. *Leucophoyx thula*
11. *Dichromanassa rufescens*
12. *Tigrisoma lineatum*
13. *Ardeola speciosa*
14. *Ixobrychus strumii*
15. *Egretta garzetta*
16. *Ardea melanocephala*
17. *Egretta intermedia*
18. *Ardea pacifica*
19. *Ardeola ralloides*
20. *Ixobrychus involucris*
21. *Butorides virescens*
22. *Butorides striatus*
23. *Erythocnus rufiventris*
24. *Ardeola bacchus*
25. *Ixobrychus exilis*
26. *Tigriornis leucolopha*
27. *Cochlearius cochlearius*
28. *Ardea occidentalis*
29. *Ardea herodias*
30. *Hydranassa tricolor*
31. *Ardea goliath*
32. *Ardea cinerea*
33. *Casmerodius albus*
34. *Ardea sumatrana*
35. *Ixobrychus sinensis*
36. *Ardea cocoi*
37. *Botaurus lentiginosus*
38. *Botaurus stellaris*
39. *Ardea purpurea*
40. *Ixobrychus cinnamomeus*

Preorbital/Cranium:

1. *Tigrisoma mexicana*
2. *Casmerodius albus*
3. *Ixobrychus involucris*
4. *Ixobrychus exilis*
5. *Ardea purpurea*
6. *Hydranassa tricolor*
7. *Ixobrychus sinensis*
8. *Gorsachius melanolophus*
9. *Syrigma sibilatrix*
10. *Tigrisoma lineatum*
11. *Bubulcus ibis*
12. *Ixobrychus strumii*
13. *Florida caerulea*
14. *Pilherodius pileatus*
15. *Egretta garzetta*
16. *Ardea pacifica*
17. *Dichromanassa rufescens*
18. *Ardea occidentalis*
19. *Leucophoyx thula*
20. *Ardea herodias*
21. *Tigriornis leucolopha*
22. *Butorides virescens*
23. *Egretta intermedia*
24. *Ardeola ralloides*
25. *Ardea sumatrana*
26. *Ardeola speciosa*
27. *Erythocnus rufiventris*
28. *Botaurus lentiginosus*
29. *Nyctanassa violacea*
30. *Butorides striatus*
31. *Nycticorax caledonicus*
32. *Ardea cinerea*
33. *Botaurus stellaris*
34. *Ardea melanocephala*
35. *Ardeola bacchus*
36. *Ardea goliath*
37. *Nycticorax nycticorax*
38. *Ardea cocoi*
39. *Ixobrychus cinnamomeus*
40. *Cochlearius cochlearius*

Postorbital/Cranium:

1. *Casmerodius albus*
2. *Ardea purpurea*
3. *Ixobrychus sinensis*
4. *Hydranassa tricolor*
5. *Ixobrychus exilis*
6. *Ixobrychus involucris*
7. *Ardea sumatrana*
8. *Botaurus lentiginosus*
9. *Botaurus stellaris*
10. *Ardea herodias*
11. *Ardea occidentalis*
12. *Ardea cocoi*
13. *Tigriornis leucolopha*
14. *Ardea cinerea*
15. *Tigrisoma mexicana*
16. *Ixobrychus cinnamomeus*
17. *Ardea pacifica*
18. *Butorides virescens*
19. *Erythocnus rufiventris*
20. *Ardeola ralloides*
21. *Egretta intermedia*
22. *Ardea goliath*
23. *Butorides striatus*
24. *Ixobrychus strumii*
25. *Tigrisoma lineatum*
26. *Egretta garzetta*
27. *Ardeola bacchus*
28. *Pilherodius pileatus*
29. *Dichromanassa rufescens*
30. *Florida caerulea*
31. *Leucophoyx thula*
32. *Ardea melanocephala*
33. *Ardeola speciosa*
34. *Syrigma sibilatrix*
35. *Bubulcus ibis*
36. *Gorsachius melanolophus*
37. *Nyctanassa violacea*
38. *Nycticorax nycticorax*
39. *Nycticorax caledonicus*
40. *Cochlearius cochlearius*

Pterygoid/Quadrate length:

1. Ardea goliath
2. Ixobrychus cinnamomeus
3. Nyctanassa violacea
4. Ardea sumatrana
5. Ardea cocoi
6. Ardea melanocephala
7. Ardea cinerea
8. Egretta intermedia
9. Botaurus lentiginosus
10. Casmerodius albus
11. Nycticorax nycticorax
12. Ardea purpurea
13. Nycticorax caledonicus
14. Ardea herodias
15. Ardeola speciosa
16. Botaurus stellaris
17. Cochlearius cochlearius
18. Ixobrychus sinensis
19. Tigrisoma lineatum
20. Ardea occidentalis
21. Ixobrychus exilis
22. Gorsachius melanolophus
23. Erythocnus rufiventris
24. Pilherodius pileatus
25. Ardea pacifica
26. Egretta garzetta
27. Tigrisoma mexicana
28. Syrigma sibilatrix
29. Ardeola bacchus
30. Dichromanassa rufescens
31. Bubulcus ibis
32. Florida caerulea
33. Butorides virescens
34. Hydranassa tricolor
35. Butorides striatus
36. Leucophoyx thula
37. Ardeola ralloides
38. Tigriornis leucolopha
39. Ixobrychus involucris

Quadrate width/Quadrate length:

1. Ixobrychus cinnamomeus
2. Botaurus stellaris
3. Ardea cocoi
4. Ardea occidentalis
5. Ardea cinerea
6. Casmerodius albus
7. Ardea herodias
8. Ardea purpurea
9. Botaurus lentiginosus
10. Ardea melanocephala
11. Ixobrychus involucris
12. Ardea goliath
13. Ixobrychus exilis
14. Nycticorax nycticorax
15. Ardea sumatrana
16. Ixobrychus strumii
17. Butorides striatus
18. Ardeola speciosa
19. Tigriornis leucolopha
20. Egretta intermedia
21. Erythocnus rufiventris
22. Ardeola bacchus
23. Nyctanassa violacea
24. Nycticorax caledonicus
25. Ardea pacifica
26. Ardeola ralloides
27. Dichromanassa rufescens
28. Leucophoyx thula
29. Tigrisoma lineatum
30. Butorides virescens
31. Florida caerulea
32. Tigrisoma mexicana
33. Pilherodius pileatus
34. Egretta garzetta
35. Bubulcus ibis
36. Ixobrychus sinensis
37. Hydranassa tricolor
38. Gorsachius melanolophus
39. Cochlearius cochlearius
40. Syrigma sibilatrix

Intermembral ratios:

Femur/Humerus:

1. Ardea pacifica
2. Ardea cinerea
3. Egretta intermedia
4. Ardea herodias
5. Casmerodius albus
6. Syrigma sibilatrix
7. Ardea occidentalis
8. Ardea melanocephala
9. Ardea cocoi
10. Dichromanassa rufescens
11. Leucophoyx thula
12. Florida caerulea
13. Egretta garzetta
14. Ardea goliath
15. Bubulcus ibis
16. Hydranassa tricolor
17. Nyctanassa violacea
18. Gorsachius melanolophus
19. Ardea sumatrana
20. Pilherodius pileatus
21. Nycticorax nycticorax
22. Ardea purpurea
23. Nycticorax caledonicus
24. Ardeola ralloides
25. Ardeola bacchus
26. Ardeola speciosa
27. Erythocnus rufiventris
28. Tigrisoma mexicana
29. Butorides virescens
30. Ixobrychus strumii
31. Botaurus lentiginosus
32. Butorides striatus
33. Botaurus stellaris
34. Cochlearius cochlearius
35. Tigrisoma lineatum
36. Tigriornis leucolopha
37. Ixobrychus cinnamomeus
38. Ixobrychus sinensis
39. Ixobrychus exilis
40. Ixobrychus involucris

Femur/Ulna:

1. Ardea pacifica
2. Egretta intermedia
3. Ardea cinerea
4. Casmerodius albus
5. Ardea herodias
6. Syrigma sibilatrix
7. Dichromanassa rufescens
8. Ardea occidentalis
9. Ardea melanocephala
10. Egretta garzetta
11. Leucophoyx thula
12. Florida caerulea
13. Ardea cocoi
14. Hydranassa tricolor
15. Pilherodius pileatus
16. Ardea sumatrana
17. Bubulcus ibis
18. Nyctanassa violacea
19. Gorsachius melanolophus
20. Ardea goliath
21. Ardea purpurea
22. Ardeola ralloides
23. Ardeola bacchus
24. Tigrisoma mexicana
25. Nycticorax nycticorax
26. Nycticorax caledonicus
27. Cochlearius cochlearius
28. Erythocnus rufiventris
29. Ardeola speciosa
30. Tigrisoma lineatum
31. Butorides virescens
32. Butorides striatus
33. Botaurus lentiginosus
34. Ixobrychus strumii
35. Botaurus stellaris
36. Tigriornis leucolopha
37. Ixobrychus cinnamomeus
38. Ixobrychus exilis
39. Ixobrychus involucris

Femur/Carpometacarpus:

1. *Ardea pacifica*
2. *Syrigma sibilatrix*
3. *Egretta intermedia*
4. *Dichromanassa rufescens*
5. *Ardea cinerea*
6. *Casmerodius albus*
7. *Florida caerulea*
8. *Ardea herodias*
9. *Hydranassa tricolor*
10. *Leucophoyx thula*
11. *Egretta garzetta*
12. *Ardea occidentalis*
13. *Ardea melanocephala*
14. *Pilherodius pileatus*
15. *Nyctanassa violacea*
16. *Gorsachius melanolophus*
17. *Bubulcus ibis*
18. *Ardea cocoi*
19. *Ardeola bacchus*
20. *Ardea goliath*
21. *Nycticorax nycticorax*
22. *Nycticorax caledonicus*
23. *Ardeola ralloides*
24. *Ardea purpurea*
25. *Erythocnus rufiventris*
26. *Ardea sumatrana*
27. *Botaurus lentiginosus*
28. *Ardeola speciosa*
29. *Ixobrychus strumii*
30. *Butorides virescens*
31. *Tigrisoma mexicana*
32. *Butorides striatus*
33. *Botaurus stellaris*
34. *Cochlearius cochlearius*
35. *Tigrisoma lineatum*
36. *Ixobrychus cinnamomeus*
37. *Tigriornis leucolopha*
38. *Ixobrychus sinensis*
39. *Ixobrychus exilis*
40. *Ixobrychus involucris*

Tibia/Humerus:

1. *Ardeola speciosa*
2. *Gorsachius melanolophus*
3. *Nycticorax nycticorax*
4. *Butorides striatus*
5. *Erythocnus rufiventris*
6. *Ardea pacifica*
7. *Ixobrychus strumii*
8. *Nycticorax caledonicus*
9. *Ardeola bacchus*
10. *Butorides virescens*
11. *Botaurus stellaris*
12. *Ardeola ralloides*
13. *Syrigma sibilatrix*
14. *Ardea cinerea*
15. *Botaurus lentiginosus*
16. *Ardea occidentalis*
17. *Ardea purpurea*
18. *Cochlearius cochlearius*
19. *Ardea goliath*
20. *Bubulcus ibis*
21. *Ardea melanocephala*
22. *Nyctanassa violacea*
23. *Tigrisoma mexicana*
24. *Tigrisoma lineatum*
25. *Ardea herodias*
26. *Tigriornis leucolopha*
27. *Ixobrychus cinnamomeus*
28. *Ardea sumatrana*
29. *Ixobrychus sinensis*
30. *Ardea cocoi*
31. *Hydranassa tricolor*
32. *Pilherodius pileatus*
33. *Ixobrychus exilis*
34. *Florida caerulea*
35. *Egretta intermedia*
36. *Leucophoyx thula*
37. *Casmerodius albus*
38. *Dichromanassa rufescens*
39. *Egretta garzetta*
40. *Ixobrychus involucris*

Tibia/Ulna:

1. *Ardeola speciosa*
2. *Gorsachius melanolophus*
3. *Ardea pacifica*
4. *Syrigma sibilatrix*
5. *Erythocnus rufiventris*
6. *Ardeola bacchus*
7. *Ardea cinerea*
8. *Nycticorax nycticorax*
9. *Ardeola ralloides*
10. *Nycticorax caledonicus*
11. *Ardea occidentalis*
12. *Butorides virescens*
13. *Ixobrychus strumii*
14. *Ardea sumatrana*
15. *Ardea purpurea*
16. *Tigrisoma mexicana*
17. *Botaurus stellaris*
18. *Butroides striatus*
19. *Bubulcus ibis*
20. *Tigrisoma lineatum*
21. *Ardea melanocephala*
22. *Ardea herodias*
23. *Cochlearius cochlearius*
24. *Botaurus lentiginosus*
25. *Pilherodius pileatus*
26. *Nyctanassa violacea*
27. *Tigriornis leucolopha*
28. *Ardea goliath*
29. *Hydranassa tricolor*
30. *Ardea cocoi*
31. *Egretta intermedia*
32. *Leucophoyx thula*
33. *Casmerodius albus*
34. *Dichromanassa rufescens*
35. *Florida caerulea*
36. *Ixobrychus cinnamomeus*
37. *Egretta garzetta*
38. *Ixobrychus involucris*
39. *Ixobrychus exilis*

Tibia/Carpometacarpus:

1. *Ardeola speciosa*
2. *Gorsachius melanolophus*
3. *Erythocnus rufiventris*
4. *Ardea pacifica*
5. *Nycticorax nycticorax*
6. *Ardeola bacchus*
7. *Ixobrychus strumii*
8. *Syrigma sibilatrix*
9. *Botaurus lentiginosus*
10. *Nycticorax caledonicus*
11. *Butorides striatus*
12. *Butorides virescens*
13. *Ardeola ralloides*
14. *Botaurus stellaris*
15. *Ardea cinerea*
16. *Nyctanassa violacea*
17. *Ixobrychus cinnamomeus*
18. *Ardea occidentalis*
19. *Pilherodius pileatus*
20. *Ardea purpurea*
21. *Bubulcus ibis*
22. *Tigrisoma lineatum*
23. *Tigrisoma mexicana*
24. *Hydranassa tricolor*
25. *Ardea herodias*
26. *Cochlearius cochlearius*
27. *Florida caerulea*
28. *Dichromanassa rufescens*
29. *Ardea melanocephala*
30. *Leucophoyx thula*
31. *Ixobrychus sinensis*
32. *Ardea goliath*
33. *Egretta intermedia*
34. *Tigriornis leucolopha*
35. *Egretta garzetta*
36. *Ardea sumatrana*
37. *Casmerodius albus*
38. *Ixobrychus exilis*
39. *Ardea cocoi*
40. *Ixobrychus involucris*

Tarsus/Humerus:

1. *Ixobrychus strumii*
2. *Nycticorax nycticorax*
3. *Erythocnus rufiventris*
4. *Butorides striatus*
5. *Gorsachius melanolophus*
6. *Botaurus stellaris*
7. *Ardeola bacchus*
8. *Nycticorax caledonicus*
9. *Butorides virescens*
10. *Ardeola ralloides*
11. *Ardeola speciosa*
12. *Botaurus lentiginosus*
13. *Ixobrychus cinnamomeus*
14. *Cochlearius cochlearius*
15. *Tigriornis leucolopha*
16. *Syrigma sibilatrix*
17. *Ardea pacifica*
18. *Ixobrychus involucris*
19. *Ixobrychus sinensis*
20. *Ardea cinerea*
21. *Tigrisoma mexicana*
22. *Ardea purpurea*
23. *Ixobrychus exilis*
24. *Bubulcus ibis*
25. *Ardea goliath*
26. *Ardea sumatrana*
27. *Tigrisoma lineatum*
28. *Ardea occidentalis*
29. *Ardea melanocephala*
30. *Nyctanassa violacea*
31. *Ardea herodias*
32. *Pilherodius pileatus*
33. *Egretta garzetta*
34. *Ardea cocoi*
35. *Florida caerulea*
36. *Leucophoyx thula*
37. *Hydranassa tricolor*
38. *Egretta intermedia*
39. *Casmerodius albus*
40. *Dichromanassa rufescens*

Tarsus/Ulna:

1. *Gorsachius melanolophus*
2. *Ardeola bacchus*
3. *Erythocnus rufiventris*
4. *Nycticorax nycticorax*
5. *Ixobrychus strumii*
6. *Ardeola ralloides*
7. *Butorides striatus*
8. *Botaurus stellaris*
9. *Butorides virescens*
10. *Nycticorax caledonicus*
11. *Ardeola speciosa*
12. *Syrigma sibilatrix*
13. *Cochlearius cochlearius*
14. *Tigriornis leucolopha*
15. *Ardea sumatrana*
16. *Ardea pacifica*
17. *Tigrisoma mexicana*
18. *Botaurus lentiginosus*
19. *Ardea cinerea*
20. *Ardea purpurea*
21. *Ixobrychus cinnamomeus*
22. *Bubulcus ibis*
23. *Tigrisoma lineatum*
24. *Ardea goliath*
25. *Pilherodius pileatus*
26. *Ardea melanocephala*
27. *Ardea occidentalis*
28. *Ardea herodias*
29. *Nyctanassa violacea*
30. *Ixobrychus involucris*
31. *Egretta garzetta*
32. *Ixobrychus exilis*
33. *Leucophoyx thula*
34. *Egretta intermedia*
35. *Florida caerulea*
36. *Ardea cocoi*
37. *Hydranassa tricolor*
38. *Casmerodius albus*
39. *Dichromanassa rufescens*

Tarsus/Carpometacarpus:

1. Ixobrychus strumii
2. Erythocnus rufiventris
3. Ardeola bacchus
4. Nycticorax nycticorax
5. Gorsachius melanolophus
6. Botaurus stellaris
7. Butorides striatus
8. Ardeola ralloides
9. Nycticorax caledonicus
10. Butorides virescens
11. Botaurus lentiginosus
12. Ixobrychus cinnamomeus
13. Ardeola speciosa
14. Syrigma sibilatrix
15. Ardea pacifica
16. Cochlearius cochlearius
17. Tigrisoma mexicana
18. Ardea cinerea
19. Ardea purpurea
20. Tigriornis leucolopha
21. Nyctanassa violacea
22. Bubulcus ibis
23. Ixobrychus sinensis
24. Ixobrychus involucris
25. Tigrisoma lineatum
26. Pilherodius pileatus
27. Ixobrychus exilis
28. Ardea occidentalis
29. Hydranassa tricolor
30. Ardea herodias
31. Florida caerulea
32. Ardea melanocephala
33. Ardea goliath
34. Egretta garzetta
35. Ardea sumatrana
36. Leucophoyx thula
37. Egretta intermedia
38. Dichromanassa rufescens
39. Casmerodius albus
40. Ardea cocoi

Hallux/Humerus:

1. Ardea cinerea
2. Nyctanassa violacea
3. Ardea melanocephala
4. Gorsachius melanolophus
5. Ardea herodias
6. Dichromanassa rufescens
7. Ardea pacifica
8. Ardea occidentalis
9. Ardea cocoi
10. Nycticorax nycticorax
11. Casmerodius albus
12. Nycticorax caledonicus
13. Egretta garzetta
14. Leucophoyx thula
15. Cochlearius cochlearius
16. Syrigma sibilatrix
17. Erythocnus rufiventris
18. Ardea sumatrana
19. Ardea goliath
20. Botaurus stellaris
21. Tigrisoma lineatum
22. Tigrisoma mexicana
23. Ardeola bacchus
24. Hydranassa tricolor
25. Ardeola ralloides
26. Florida caerulea
27. Egretta intermedia
28. Bubulcus ibis
29. Tigriornis leucolopha
30. Pilherodius pileatus
31. Butorides striatus
32. Ixobrychus strumii
33. Ardeola speciosa
34. Butorides virescens
35. Botaurus lentiginosus
36. Ardea purpurea
37. Ixobrychus cinnamomeus
38. Ixobrychus sinensis
39. Ixobrychus involucris
40. Ixobrychus exilis

Hallux/Ulna:

1. *Ardea cinerea*
2. *Dichromanassa rufescens*
3. *Ardea melanocephala*
4. *Nyctanassa violacea*
5. *Gorsachius melanolophus*
6. *Ardea herodias*
7. *Ardea pacifica*
8. *Ardea occidentalis*
9. *Casmerodius albus*
10. *Ardea cocoi*
11. *Egretta garzetta*
12. *Ardea sumatrana*
13. *Leucophoyx thula*
14. *Pilherodius pileatus*
15. *Syrigma sibilatrix*
16. *Nycticorax nycticorax*
17. *Tigrisoma lineatum*
18. *Nycticorax caledonicus*
19. *Cochlearius cochlearius*
20. *Tigrisoma mexicana*
21. *Hydranassa tricolor*
22. *Egretta intermedia*
23. *Erythocnus rufiventris*
24. *Ardeola bacchus*
25. *Ardea goliath*
26. *Florida caerulea*
27. *Ardeola ralloides*
28. *Bubulcus ibis*
29. *Tigriornis leucolopha*
30. *Botaurus stellaris*
31. *Ardeola speciosa*
32. *Butorides virescens*
33. *Butorides striatus*
34. *Ixobrychus strumii*
35. *Ardea purpurea*
36. *Botaurus lentiginosus*
37. *Ixobrychus cinnamomeus*
38. *Ixobrychus sinensis*
39. *Ixobrychus exilis*

Hallux/Carpometacarpus:

1. *Ardea cinerea*
2. *Dichromanassa rufescens*
3. *Nyctanassa violacea*
4. *Gorsachius melanolophus*
5. *Ardea pacifica*
6. *Ardea herodias*
7. *Ardea melanocephala*
8. *Ardea occidentalis*
9. *Nycticorax caledonicus*
10. *Syrigma sibilatris*
11. *Nycticorax nycticorax*
12. *Egretta garzetta*
13. *Casmerodius albus*
14. *Leucophoyx thula*
15. *Erythocnus rufiventris*
16. *Ardeola bacchus*
17. *Hydranassa tricolor*
18. *Ardea cocoi*
19. *Pilherodius pileatus*
20. *Florida caerulea*
21. *Botaurus stellaris*
22. *Tigrisoma lineatum*
23. *Ardeola ralloides*
24. *Cochlearius cochlearius*
25. *Tigrisoma mexicana*
26. *Tigriornis leucolopha*
27. *Egretta intermedia*
28. *Ixobrychus strumii*
29. *Ardea sumatrana*
30. *Bubulcus ibis*
31. *Ardea goliath*
32. *Botaurus lentiginosus*
33. *Butorides virescens*
34. *Butorides striatus*
35. *Ardeola speciosa*
36. *Ixobrychus cinnamomeus*
37. *Ardea purpurea*
38. *Ixobrychus sinensis*
39. *Ixobrychus involucris*
40. *Ixobrychus exilis*

Intramembral Ratios:

Humerus/Ulna:

1. Pilherodius pileatus
2. Ardea sumatrana
3. Egretta garzetta
4. Dichromanassa rufescens
5. Egretta intermedia
6. Leucophoyx thula
7. Casmerodius albus
8. Syrigma sibilatrix
9. Tigrisoma lineatum
10. Tigrisoma mexicana
11. Hydranassa tricolor
12. Ardea pacifica
13. Ardea herodias
14. Florida caerulea
15. Ardea cocoi
16. Ardea cinerea
17. Ardea melanocephala
18. Ardea goliath
19. Gorsachius melanolophus
20. Nyctanassa violacea
21. Ardeola bacchus
22. Ardea occidentalis
23. Ardea purpurea
24. Tigriornis leucolopha
25. Bubulcus ibis
26. Cochlearius cochlearius
27. Ardeola ralloides
28. Erythocnus rufiventris
29. Ardeola speciosa
30. Butorides virescens
31. Nycticorax nycticorax
32. Nycticorax caledonicus
33. Butorides striatus
34. Botaurus lentiginosus
35. Botaurus stellaris
36. Ixobrychus strumii
37. Ixobrychus cinnamomeus
38. Ixobrychus involucris
39. Ixobrychus exilis

Radius/Ulna:

1. Ardea sumatrana
2. Ixobrychus cinnamomeus
3. Tigriornis leucolopha
4. Ardeola speciosa
5. Cochlearius cochlearius
6. Ardeola bacchus
7. Tigrisoma lineatum
8. Ixobrychus exilis
9. Ardea cocoi
10. Tigrisoma mexicana
11. Ardeola ralloides
12. Erythocnus rufiventris
13. Ixobrychus strumii
14. Botaurus lentiginosus
15. Pilherodius pileatus
16. Butorides virescens
17. Botaurus stellaris
18. Nycticorax caledonicus
19. Ardea goliath
20. Butorides striatus
21. Nyctanassa violacea
22. Nycticorax nycticorax
23. Syrigma sibilatrix
24. Ixobrychus involucris
25. Egretta garzetta
26. Florida caerulea
27. Ardea purpurea
28. Bubulcus ibis
29. Casmerodius albus
30. Egretta intermedia
31. Leucophoyx thula
32. Ardea pacifica
33. Ardea occidentalis
34. Gorsachius melanolophus
35. Dichromanassa rufescens
36. Ardea herodias
37. Ardea cinerea
38. Ardea melanocephala
39. Hydranassa tricolor

Carpometacarpus/Ulna:

1. Ardea sumatrana
2. Ardea goliath
3. Ardea cocoi
4. Ardea melanocephala
5. Tigriornis leucolopha
6. Casmerodius albus
7. Ardea herodias
8. Cochlearius cochlearius
9. Tigrisoma mexicana
10. Ardea occidentalis
11. Ardea cinerea
12. Tigrisoma lineatum
13. Egretta intermedia
14. Bubulcus ibis
15. Egretta garzetta
16. Ardea purpurea
17. Pilherodius pileatus
18. Leucophoyx thula
19. Gorsachius melanolophus
20. Nyctanassa violacea
21. Ardeola ralloides
22. Ardea pacifica
23. Dichromanassa rufescens
24. Ardeola speciosa
25. Syrigma sibilatrix
26. Florida caerulea
27. Hydranassa tricolor
28. Butorides striatus
29. Butorides virescens
30. Ixobrychus involucris
31. Nycticorax caledonicus
32. Nycticorax nycticorax
33. Ardeola bacchus
34. Botaurus stellaris
35. Erythocnus rufiventris
36. Ixobrychus exilis
37. Ixobrychus strumii
38. Botaurus lentiginosus
39. Ixobrychus cinnamomeus

Digit 2, Phalanx 1/Ulna:

1. Ardea sumatrana
2. Ardea melanocephala
3. Tigrisoma lineatum
4. Casmerodius albus
5. Tigrisoma mexicana
6. Ardea occidentalis
7. Ardea cocoi
8. Egretta intermedia
9. Tigriornis leucolophs
10. Ardea herodias
11. Ardea cinerea
12. Dichromanassa rufescens
13. Botaurus stellaris
14. Leucophoyx thula
15. Ardea purpurea
16. Ardea goliath
17. Gorsachius melanolophus
18. Pilherodius pileatus
19. Ardeola bacchus
20. Ixobrychus exilis
21. Ardeola ralloides
22. Butorides virescens
23. Erythocnus rufiventris
24. Egretta garzetta
25. Cochlearius cochlearius
26. Botaurus lentiginosus
27. Ardeola speciosa
28. Nyctanassa violacea
29. Bubulcus ibis
30. Ardea pacifica
31. Syrigma sibilatrix
32. Nycticorax caledonicus
33. Ixobrychus cinnamomeus
34. Butorides striatus
35. Hydranassa tricolor
36. Nycticorax nycticorax
37. Florida caerulea
38. Ixobrychus strumii
39. Ixobrychus involucris

Digit 2, Phalanx 2/Ulna:

1. *Tigriornis leucolopha*
2. *Ardea sumatrana*
3. *Tigrisoma lineatum*
4. *Florida caerulea*
5. *Ardea goliath*
6. *Ardea purpurea*
7. *Hydranassa tricolor*
8. *Gorsachius melanolophus*
9. *Ardea herodias*
10. *Tigrisoma mexicana*
11. *Ardea cinerea*
12. *Ardea melanocephala*
13. *Casmerodius albus*
14. *Botaurus stellaris*
15. *Ardea occidentalis*
16. *Dichromanassa rufescens*
17. *Egretta intermedia*
18. *Botaurus lentiginosus*
19. *Ardea cocoi*
20. *Pilherodius pileatus*
21. *Nyctanassa violacea*
22. *Syrigma sibilatrix*
23. *Cochlearius cochlearius*
24. *Leucophcyx thula*
25. *Nycticorax caledonicus*
26. *Ardea pacifica*
27. *Butorides striatus*
28. *Nycticorax nycticorax*
29. *Butorides virescens*
30. *Ixobrychus exilis*
31. *Ixobrychus cinnamomeus*
32. *Erythocnus rufiventris*
33. *Ardeola ralloides*
34. *Egretta garzetta*
35. *Ixobrychus involucris*
36. *Bubulcus ibis*
37. *Ixobrychus strumii*
38. *Ardeola bacchus*
39. *Ardeola speciosa*

Femur/Tibia:

1. *Egretta intermedia*
2. *Casmerodius albus*
3. *Dichromanassa rufescens*
4. *Egretta garzetta*
5. *Leucophoyx thula*
6. *Florida caerulea*
7. *Ardea herodias*
8. *Ardea cocoi*
9. *Hydranassa tricolor*
10. *Ardea pacifica*
11. *Ardea melanocephala*
12. *Ardea cinerea*
13. *Ardea occidentalis*
14. *Syrigma sibilatrix*
15. *Pilherodius pileatus*
16. *Ardea goliath*
17. *Bubulcus ibis*
18. *Ardea sumatrana*
19. *Nyctanassa violacea*
20. *Ardea purpurea*
21. *Gorsachius melanolophus*
22. *Tigrisoma lineatum*
23. *Tigrisoma mexicana*
24. *Cochlearius cochlearius*
25. *Ardeola ralloides*
26. *Nycticorax caledonicus*
27. *Ardeola bacchus*
28. *Nycticorax nycticorax*
29. *Butorides virescens*
30. *Botaurus lentiginosus*
31. *Erythocnus rufiventris*
32. *Botaurus stellaris*
33. *Butorides striatus*
34. *Tigriornis leucolopha*
35. *Ixobrychus cinnamomeus*
36. *Ixobrychus exilis*
37. *Ixobrychus sinensis*
38. *Ixobrychus involucris*
39. *Ixobrychus strumii*
40. *Ardeola speciosa*

Tarsometatarsus/Tibiotarsus:

1. Botaurus stellaris
2. Ixobrychus strumii
3. Ixobrychus involucris
4. Ixobrychus cinnamomeus
5. Ixobrychus exilis
6. Erythocnus rufiventris
7. Ardeola bacchus
8. Ardeola ralloides
9. Butorides striatus
10. Butorides virescens
11. Nycticorax nycticorax
12. Nycticorax caledonicus
13. Tigriornis leucolopha
14. Cochlearius cochlearius
15. Ixobrychus sinensis
16. Gorsachius melanolophus
17. Botaurus lentiginosus
18. Ardea sumatrana
19. Egretta garzetta
20. Tigrisoma mexicana
21. Ardea goliath
22. Bubulcus ibis
23. Ardea purpurea
24. Tigrisoma lineatum
25. Syrigma sibilatrix
26. Florida caerulea
27. Pilherodius pileatus
28. Nyctanassa violacea
29. Ardea melanocephala
30. Leucophoyx thula
31. Egretta intermedia
32. Ardea herodias
33. Ardea cocoi
34. Ardea cinerea
35. Casmerodius albus
36. Hydranassa tricolor
37. Ardea occidentalis
38. Ardea pacifica
39. Dichromanassa rufescens
40. Ardeola speciosa

Hallux/Tibiotarsus

1. Dichromanassa rufescens
2. Casmerodius albus
3. Ardea cinerea
4. Nyctanassa violacea
5. Ardea melanolephala
6. Ardea herodias
7. Egretta garzetta
8. Ardea cocoi
9. Leucophoyx thula
10. Ardea occidentalis
11. Ardea pacifica
12. Egretta intermedia
13. Florida caerulea
14. Hydranassa tricolor
15. Cochlearius cochlearius
16. Gorsachius melanolophus
17. Ardea sumatrana
18. Pilherodius pileatus
19. Ardea goliath
20. Tigrisoma lineatum
21. Tigrisoma mexicana
22. Nycticorax caledonicus
23. Tigriornis leucolopha
24. Nycticorax nycticorax
25. Syrigma sibilatrix
26. Bubulcus ibis
27. Botaurus stellaris
28. Ardeola bacchus
29. Ardeola ralloides
30. Erythocnus rufiventris
31. Ixobrychus involucris
32. Ixobrychus cinnamomeus
33. Butorides virescens
34. Ixobrychus exilis
35. Ardea purpurea
36. Butorides striatus
37. Ixobrychus sinensis
38. Botaurus lentiginosus
39. Ixobrychus strumii
40. Ardeola speciosa

QUALITATIVE CHARACTERS

Those physical characters not lending themselves readily to measurement were compared before final analyses of the statistical data were made.

Internasal septum. Although Shufeldt (1889a, 1889b, 1901) states that the internasal septum is very incomplete or altogether missing in the subfamily Ardeinae, my investigations indicate that the condition of the nares is sufficient to divide the representative forms of the family Ardeidae into two well defined groups, with a third group having intermediate condition.

In one extreme condition, the nares are completely divided into two well defined passages by a thin sheet of osseous material extending diagonally from the antero-dorsal to the postero-ventral angles of the nares. The forms showing this condition are as follows: *Pilherodius pileatus*, *Nycticorax n. nycticorax*, *N. n. hoactli*, *Tigriornis leucolopha*, and *Tigrisoma mexicana*.

The other extreme is represented by the condition in which there is no septum. This condition occurs in *Ardea sumatrana*, *A. goliath*, *A. melanocephala*, *A. herodias treganzai*, *A. h. herodias*, *A. occidentalis*, *A. pacifica*, *A. purpurea*, *Butorides v. virescens*, *B. striatus*, *Ardeola ralloides*, *A. bacchus*, *A. speciosa*, *Dichromanassa rufescens*, and *Hydranassa tricolor*.

An intermediate condition exists in which there is a small projection of bone from the dorso-medial surface of the nares. This is present in the following forms: *Florida caerulea*, *Casmerodius albus*

egretta, *C. a. modestus*, *Egretta intermedia*, *Leucophoyx thula*, *Syrigma sibilatrix*, *Nycticorax caledonicus*, *Nyctanassa v. violacea*, *N. v. bancrofti*, *Gorsachius melanolophus*, *Tigrisoma lineatum*, *Ixobrychus sinensis*, *I. involucris*, *I. exilis*, *I. cinnamomeus*, *I. strumii*, *Botaurus stellaris*, and *B. lentiginosus*.

Supraorbital vacuities. These are a pair of greatly enlarged foramina which Shufeldt (1889a) termed the olfactory foramina. They lie on the antero-ventral angle of the brain case immediately above the orbits and on either side of the interorbital septum. Variations in the shape and structure of these facuities make it possible to separate the members of the family into several groups.

The extreme conditions occur in the genus *Ardea*. The vacuities are of average size in all forms except *A. goliath* and *A. pacifica*, the largest and smallest forms, respectively, of the genus. In *A. pacifica* the paired vacuities are greatly enlarged, exposing fully half of the ventral surface of the brain. The opposite condition occurs in *A. goliath*. In this form these openings are greatly reduced and are only large enough for the passage of a small nerve.

A modification in the shape of these vacuities makes it possible to separate two genera, i. e. *Nycticorax* and *Tigriornis*, from the remainder of the family. In these genera each vacuity is divided by a small bony projection extending postero-dorsally from the medial septum, thus producing four greatly reduced openings. *Nycticorax caledonicus* shows the greatest modification with the partition being much broadened. The partition is also present in *Nycticorax n. nycticorax* and *N. n. hoactli* in varying degrees, some specimens having a complete partition, others having an incomplete partition.

The supraorbital vacuities are absent in Tigrisoma lineatum, T. mexicana, Nyctanassa v. violacea, N. v. bancrofti, and Cochlearius cochlearius.

Ectethmoid: The ethmoid as described by Shufeldt (1889a, 1889b, 1901) is a composite bone bearing a pair of opposing lateral extensions which are here referred to as the ectethmoids. Each of these is divisible into a superior and inferior process. The superior process is in intimate contact with the superior process of the lacrimal and lies just posterior to the cranio-facial hinge. The inferior process is a flattened, truncate projection extending laterally and ventrally from the base of the ethmoid.

On the basis of the contour and conformation of the ectethmoid, members of the family Ardeidae may be divided into three definite groups; one showing a separation and reduction of the superior and inferior processes, another with both portions of normal size and connected by a bony bridge, the third being characterized by the loss of the bridge and complete reduction of the inferior process.

The following forms fall into the first category: Dichromanassa rufescens, Casmerodius albus egretta, C. a. modestus, Egretta garzetta garzetta, E. g. nigripes, Hydranassa tricolor, Butorides v. virescens, B. striatus, Florida caerulea, Ardeola ralloides, A. bacchus, A. speciosa, Bubulcus ibis, Leucophoyx thula, Nyctanassa v. violacea, N. v. bancrofti, Gorsachius melanolophus, Tigrisoma lineatum, T. mexicana, Botaurus *stellaris*, *B. lentiginosus*, *Ixobrychus sinensis*, *I. involucris*, *I. exilis*, *I. cinnamomeus*, and *I. strumii*.

Group two, in which both portions are of normal size and connected by a bony bridge, is best exemplified by the genus *Nycticorax*. In this genus the superior process extends dorsally and is in intimate contact with the dorso-medial portion of the lacrimal. The inferior process is elongate and flattened, and is in contact with the zygomatic process of the lacrimal. The two portions of the ectethmoid are connected by a delicate bony bridge. A deep groove lies beneath the ectethmoid bridge passing anteriorly from the supraorbital foramina. Anterior to the bridge the groove passes into a number of minute ramifications, and disappears near the posterior margin of the ethmoid bone. This condition is characteristic of *Nycticorax n. nycticorax*, *N. n. hoactli*, *N. caledonicus*, *Ardea h. herodias*, *A. h. treganzai*, *A. occidentalis*, *A. cinerea*, *Pilherodius pileatus*, and *Syrigma sibilatrix*.

The third condition is one of complete reduction, or absence of the inferior process and the connecting bridge. This condition is characteristic of *Tigriornis leucolopha* and *Cochlearius cochlearius*.

Lacrimal: The lacrimal is a highly pneumatic bone which fills the space between the frontal, orbitosphenoid, and ethmoid, and always forms the anterior part of the orbit (Newton, 1896). In the Ardeidae it articulates with frontal and nasal bones dorsally, and shows considerable variation in the conformation of the ventral or inferior process. The variation of the inferior process is of some value in indicating relationships within the family.

In the following discussion the portion articulating with the nasal, frontal and orbitosphenoid will be referred to as the superior process, while the postero-ventral projection will be referred to as the inferior process. Within the family there are two basic designs, each showing characteristic modifications which may be correlated with modifications previously discussed under the ectethmoid. The first is the type common to the genus *Ardea* with greatly enlarged inferior and superior processes. The inferior process lies in a plane parallel with the zygoma and is grooved ventrally to receive the zygoma. A medial extension of the inferior process attaches by ligaments to the ectethmoid. These two connections, to the zygoma and the ectethmoid, lend added strength to the skull and prevent excessive flexing of the culmen at the level of the cranio-facial hinge. This type lacrimal is common to *Ardea sumatrana*, *A. goliath*, *A. melanocephala*, *A. cinerea*, *A. h. herodias*, *A. h. treganzai*, *A. occidentalis*, *A. cocoi*, *A. purpurea*, *Casmerodius albus egretta*, *C. a. modestus*, *Tigrisoma lineatum*, and *T. mexicana*.

The second basic type exhibits a much reduced inferior process projecting diagonally in a postero-ventral direction. These may be further divided into two groups, one with the ventral border of the inferior process notched, the other with this surface entire. In neither group is the inferior process in contact with the zygoma or the ectethmoid. The following forms fall into the first sub-group: *Butorides v. virescens*, *B. striatus*, *Florida caerulea*, *Ardeola speciosa*, *A. bacchus*, *A. ralloides*, *Bubulcus ibis*, *Dichromanassa rufescens*, *Egretta g. garzetta*, *E. g. nigripes*, *E. intermedia*, *Leucophoyx thula*, *Hydranassa tricolor*, *Syrigma* *sibilatrix*, *Nyctanassa v. violacea*, *N. v. bancrofti*, *Gorsachius melanolophus*, *Botaurus lentiginosus*, *B. stellaris*, *Ixobrychus sinensis*, *I. involucris*, *I. exilis*, *I. cinnamomeus*, and *I. strumii*. The second sub-group includes only the following forms: *Nycticorax n. nycticorax*, *N. n. hoactli*, and *N. caledonicus*.

The condition of the notch in the first sub-group shows considerable variation. It is most evident in *Dichromanassa*, *Casmerodius*, *Egretta*, and *Hydranassa*. The notch is slight but still evident in *Butorides*, *Florida*, *Ardeola*, *Bubulcus*, and *Leucophoyx*. Another projection is also evident on the inferior process in *Casmerodius albus* and *Egretta alba*. This projection extends anteriorly from the base of the inferior process, giving the lacrimal the generalized appearance of an "I", with the base forming an acute angle with the zygoma. This additional process gives the lacrimal of these two forms a diagnostic character not evident in the remainder of the herons.

The asymmetrical condition of the inferior process in sub-group one is evident in the expansion of the medial projection of the notched distal end. This expansion apparently compensates for the reduction of the inferior process of the ectethmoid, and may be directly correlated with this reduction.

A sculptured condition of the lateral surface of the lacrimal is evident in three genera, namely, *Ardea*, *Tigriornis*, and *Tigrisoma*. The lacrimal of *Ardea*, while only gently sculptured, shows a trend toward the formation of a canal across the lateral proximal portion of the inferior process. In *Tigriornis* and *Tigrisoma* the extreme condition is a deep notch almost completely surrounded by bone. The purpose of this canal or notch is not known.

In addition to the above mentioned differences a medial protuberance is present on the zygoma of *Ardea*, *Tigriornis* and *Tigrisoma* at the point of articulation with the lacrimal. This protuberance gives additional strength to the bony complex supporting the anterior part of the cranium and the base of the culmen in the larger, more robust forms of the family Ardeidae.

Furculum: The structure of the hypocleidium of the furculum is sufficiently distinct to divide the representatives of the family into five distinct groups. Groups one and two are characterized by the condition of the inferior process, i. e., truncate, or short and notched. Groups three and four are characterized by the condition of the superior process, i.e., spatulate, or short and pointed. The absence of both the inferior and superior process is the criterion for group five.

Group one exhibits the truncate inferior process and includes the following forms: *Ardea cocoi*, *A. sumatrana*, *A. h. herodias*, *A. melanocephala*, *A. h. treganzai*, *A. occidentalis*, *A. cinerea*, *A. goliath*, *A. purpurea*, *A. pacifica*, *Butorides v. virescens*, *B. striatus*, *Florida caerulea*, *Ardeola ralloides*, *A. bacchus*, *A. speciosa*, *Bubulcus ibis*, *Casmerodius albus egretta*, *C. a. modestus*, *Egretta g. garzetta*, *E. g. nigripes*, *E. intermedia*, *Leucophoyx thula*, *Hydranassa tricolor*, *Nyctanassa v. violacea*, and *N. v. bancrofti*.

Group two exhibits the short notched inferior process which is characteristic of the following forms: *Pilherodius pileatus*, *Erythocnus* *rufiventris*, *Dichromanassa rufescens*, *Syrigma sibilatrix*, *Nycticorax n. nycticorax*, *N. n. hoactli*, *N. caledonicus*, *Gorsachius melanolophus*, *Ixobrychus sinensis*, *I. involucris*, *I. exilis*, *I. cinnamomeus*, *I. strumii*, *Botaurus stellaris*, and *B. lentiginosus*.

Group three exhibits the spatulate superior process of the hypocleidium which is characteristic of the following forms: *Ardea cocoi*, *A. h. herodias*, *A. h. treganzai*, *A. occidentalis*, *A. cinerea*, *A. goliath*, *Pilherodius pileatus*, *Florida caerulea*, *Dichromanassa rufescens*, *Casmerodius albus egretta*, *C. a. modestus*, *E. g. garzetta*, *E. g. nigripes*, *E. intermedia*, *Leudophoyx thula*, *Hydranassa tricolor*, *Nycticorax n. nycticorax*, *N. n. hoactli*, *N. caledonicus*, *Nyctanassa v. violacea*, *N. v. bancrofti*, and *Gorsachius melanolophus*.

Group four exhibits the short, pointed superior process of the hypocleidium which is characteristic of the following forms: *Ardea pacifica*, *A. purpurea*, *Butorides v. virescens*, *B. striatus*, *Ardeola ralloides*, *A. bacchus*, *A. speciosa*, *Bubulcus ibis*, *Syrigma sibilatrix*, *Ixobrychus sinensis*, *I. involucris*, *I. exilis*, *I. cinnamomeus*, *I. strumii*, *Botaurus stellaris*, and *B. lentiginosus*.

Group five exhibits a unique condition of the furculum in which both the inferior and superior processes of the hypocleidium are absent. The apex of the furculum forms a smooth rounded surface for articulation with the carina. This group includes *Tigriornis leucolopha*, *Tigrisoma lineatum*, and *T. mexicana*.

Further investigations showed that the truncate inferior process may be in combination with either of the variations of the inferior process. Likewise, the short notched inferior process may be in combination with either type of superior process. On this basis the following groups were observed:

Group I is exemplified by the truncate inferior, and the spatulate superior processes. This group includes the following forms: *Ardea sumatrana*, *A. cocoi*, *A. h. herodias*, *A. h. treganzai*, *A. occidentalis*, *A. cinerea*, *A. melanocephala*, *A. goliath*, *Florida caerulea*, *Casmerodius albus egretta*, *C. a. modestus*, *Egretta g. garzetta*, *E. g. nigripes*, *E. intermedia*, *Leucophoyx thula*, *Hydranassa tricolor*, *Nyctanassa v. violacea*, and *N. v. bancrofti*.

Group II combines the truncate inferior process with the short pointed superior process and includes the following forms: *Ardea purpurea*, *A. pacifica*, *Butorides v. virescens*, *B. striatus*, *Ardeola ralloides*, *A. bacchus*, *A. speciosa*, and *Bubulcus ibis*.

Group III combines the short, notched inferior process with the spatulate superior process and includes the following forms: *Pilherodius pileatus*, *Dichromanassa rufescens*, *Nycticorax n. nycticorax*, *N. n. hoactli*, *N. caledonicus*, *Gorsachius melanolophus*, and *Cochlearius cochlearius*.

Group IV combines the short, notched inferior process with the short, pointed superior process and is restricted to the subfamily Botaurinae. The following forms were found to belong to this group: *Erythocnus rufiventris*, *Syrigma sibilatrix*, *Ixobrychus sinensis*, *I. involucris*, *I. exilis*, *I. cinnamomeus*, *I. strumii*, *Botaurus stellaris*, and *B. lentiginosus*.

An examination of the carinae of the various forms was made and shows that the condition of the anterior articular surface may be predicted if the condition of the furculum is known. Those forms possessing a truncate inferior process of the hypocleidium invariably show a broad, flattened articular surface of the carina. Forms in which the inferior process is absent, or is short and notched, articulate with a sharply pointed anterior surface of the carina.

These latter combinations of the conditions of the hypocleidium (Groups I - IV) show a more definite grouping within the family than do the former. It will be noted that Groups I and II include the majority of the true-herons, and indicate a possible trend from Group I to Group II through Ardea purpurea and A. pacifica. Groups III and IV include all bitterns and night herons, with the exception of the genus Nyctanassa.

Coracoid: Newton (1896) states that the coracoid is one of the most characteristic bones of the ornithic skeleton, and that the condition of the procoracoid is of taxonomic value in higher categories.

Examination of the procoracoid of herons shows that this process is quite similar throughout the family thus making it useless as a diagnostic character on the generic level.

Examination of the proximal end of the coracoid showed sufficient difference to warrant separation of two genera, i.e., Casmerodius and Egretta, from the remainder of the herons. In both genera the sternal facet is greatly reduced in lateral extent, and is restricted to the extreme medial margin of the coracoid. In other herons the sternal facet is discernible across the entire base of the coracoid, but becomes progressively smaller toward the lateral border. Forms possessing the small sized, medially placed sternal facet include *Casmerodius albus egretta*, *C. a. modestus*, *Egretta g. garzetta*, *E. g. nigripes*, and *E. intermedia*. In these forms there is also a noticeable modification of the sterno-coracoidal impression which correlates closely with the condition of the sternal facet. This impression extends nearly or quite to the proximal border of the coracoid, but ends abruptly at the line of the sternal facet in all other herons.

The position of the intramuscular line on the ventral surface of the coracoid serves as a character for separating the herons into two groups. In one group the intramuscular line between M. suprocoracoideus and M. coracobrachialis posterior extends along the extreme lateral border for the entire length of the coracoid. Forms possessing this character are as follows: *Tigriornis leucolopha*, *Tigrisoma mexicana*, *T. lineatum*, *Botaurus stellaris*, *B. lentiginosus*, *Ixobrychus exilis*, and *Cochlearius cochlearius*. In other forms examined the intramuscular line varies from central to medial in position.

Carpometacarpus: A gross examination of this element indicates a close relationship of all forms currently assigned to this family. The condition of the tendinal groove, however, makes it possible to separate the herons into two groups. In the first group a deep tendinal groove is present and is characteristic of the following: *Ardea goliath*, *A. h. herodias*, *A. occidentalis*, *A. cinerea*, *A. purpurea*, *A. pacifica*, *Butorides v. virescens*, *B. striatus*, *Bubulcus ibis*, *Egretta g. garzetta*, *E. g. nigripes*, *E. intermedia*, *Leucophoyx thula*, *Hydranassa tricolor*, *Nycticorax n. hoactli*, *N. caledonicus*, *Gorsachius melanolophus*, *Tigriornis leucolopha*, *Tigrisoma lineatum*, *T. mexicana*, *Botaurus stellaris*, and *B. lentiginosus*. In other forms examined the tendinal groove is much reduced, and is barely discernible in some.

One additional character was noted. This is the condition of the anterior carpal fossa in the genus *Tigrisoma*. This fossa is considerably enlarged in area and depth, and is characteristic of both *Tigrisoma lineatum* and *T. mexicana*. The condition of this fossa shows only a small amount of variation in the tiger bitterns at my disposal and may possibly be considered a generic character for that group. This fossa is greatly reduced in area and depth in all other herons examined.

Tibia-fibula: Shufeldt (1889a, 1889b, 1901) states that the fibula of *Nyctanassa* is ankylosed to the tibia at its distal end. Wetmore (1918) states further that ankylosis of the fibula and the tibia occur in the herons only in *Nyctanassa*.

A critical examination of the forms at my disposal indicates that such ankylosis occur in the following forms: *Ardea cinerea*, *A. goliath*, *Bubulcus ibis*, *Casmerodius albus egretta*, *C. a. modestus*, *Egretta intermedia*, *Nycticorax caledonicus*, *Nyctanassa v. violacea*, *N. v. bancrofti*, and *Gorsachius melanolophus*.

Tarsometatarsus: The condition of the proximal end of the tarsometatarsus, the hypotarsus, is such that the representative of the family Ardeidae may be divided into four groups, two apparently forming the pattern for the family, two others being off-shoots of the basic plan.

These groups are based on the number of complete tendinal canals present in the hypotarsus.

The members of Group I have a single complete canal, flanked on two sides, i.e.: above and to one side, by an incomplete canal. Forms showing this condition are as follows: *Ardea goliath*, *A. cinerea*, *A. h. herodias*, *A. occidentalis*, *Butorides v. virescens*, *B. striatus*, *Casmerodius albus egretta*, *Egretta g. garzetta*, *Leucophoyx thula*, *Hydranassa tricolor*, *Syrigma sibilatrix*, *Nycticorax n. nycticorax*, *N. n. hoactli*, *Nyctanassa v. violacea*, *Tigriornis leucolopha*, and *Cochlearius cochlearius*.

Group II, with two complete tendinal canals in the hypotarsus may be subdivided into two categories: (a) tendinal canals laterally aligned; (b) tendinal canals dorso-ventrally aligned. Group IIa is considered basic for the family. It include the majority of the remaining forms, namely: *Ardea pacifica*, *Pilherodius pileatus*, *Ardeola ralloides*, *A. bacchus*, *A. speciosa*, *Bubulcus ibis*, *Dichromanassa rufescens*, *Casmerodius albus modestus*, *Egretta intermedia*, *Nycticorax caledonicus*, *Gorsachius melanolophus*, *Ixobrychus exilis*, *Tigrisoma lineatum*, and *T. mexicana*.

The condition in Group IIb is considered a variant of the above condition in which one canal is superimposed above the other. It is found only in *Botaurus stellaris* and *B. lentiginosus*, and therefore might be considered a generic character.

In Group III there are three complete tendinal canals in the hypotarsus. This occurs in *Florida caerulea* only.

Examination of the distal end of the tarsometatarsus shows that the characteristic tendinal bridge between the third and fourth toes is complete in all adult birds. In addition, the distal foramen is present in all forms of the subfamily Ardeinae, but is absent in the subfamily Botaurinae. This condition may be considered as a subfamily character for the Botaurinae, and might possibly imply an advanced condition of the tarsal development for that group.

Critical examination of the femur and humerus show only minor differences. In all cases variation is such that it prohibits the grouping of the herons on the basis of a femoral or humeral character.

CONCLUSIONS

Intergeneric relationships. There is a close general similarity in the major points of the osteology of the herons and bitterns, of the family Ardeidae, and the boat-billed heron of the family Cochleariidae. Because of the lack of any marked differences of osteology, and because of the great similarity of external characters, I propose that these three groups be treated as subfamilies within a single family, the Ardeidae.

I further propose that the subfamilies be characterized as follows:

Ardeinae: Bill narrow, 12 rectrices, three pairs of powder-down patches (Ridgway, 1878).

Cochleariinae: Bill broad, 12 rectrices, four pairs of powder-down patches (Wetmore, 1951).

Botaurinae: Bill narrow, 10 rectrices, two pairs of powder-down patches (Ridgway, 1878).

The subfamily Ardeinae, because of its large number of species, shows greater variation in both qualitative and quantitative characters. These variations make it possible to further subdivide this subfamily. Based on the qualitative characters (Plate 1), I propose that the following tribes be recognized:

Family Ardeidae
Subfamily Ardeinae, Herons

Of the characters plotted on Plate 1, seven are constant within the genus *Ardea*, and are assumed to be representative of the generalized ardeid form. These characters were described in detail in Section IV and will be discussed here as indicators of intergeneric relationships.

These characters are:

1. Internasal septum absent.
2. Supraorbital vacuities two.
3. Hypocleidium truncate.
4. Articular surface of carina broad and flat.
5. Sternal facet of coracoid lateral.
6. Intramuscular line of coracoid medial.
7. Tendinal groove of carpometacarpus enlarged.

Tribe 1. Ardeae, Generalized Herons. The above characters are constant for all species of three genera, Ardea, Butorides, and Hydranassa. The genus most closely related to this generalized group is Ardeola, with its three species. This genus differs in only one character, the reduction of the tendinal groove of the carpometacarpus. These four genera, with the fifteen species currently assigned to them, form a rather close-knit, generalized group, separable from the remainder of the herons.

Tribe 2. Egrettae, Egrets. The next well defined group is composed of the following genera: Casmerodius, Egretta, Bubulcus, Leucophoyx, and Florida. These forms are separated from the generalized line by the presence of an internasal septum, this being absent in the general form.

Tribe 3. Nycticoraces, Night Herons. Early in the evolution of the family, a basic separation must have taken place in the variation of the inferior process of the hypocleidium, and a corollary modification of the articular surface of the carina. Both the generalized ardeid forms and the egrets have a truncate hypocleidial process, with a broad, flattened articular surface of the carina. The opposing condition shows a short, notched hypocleidial process, with a sharply pointed articular surface of the surface of the carina. This latter condition is characteristic of the night heron line which includes the following: Dichromanassa, Pilherodius, Syrigma, Nyctanassa, Gorsachius, Nycticorax, and Erythocnus.

Tribe 4. Tigriornithes, Tiger Bitterns. A modification of the furculum separates the tiger bitterns, Tigriornis and Tigrisoma, from the generalized ardeid line in the direction of the true bitterns. This modification consists of the loss of both the superior and inferior processes of the hypocleidium, thus leaving only the smoothly rounded apex of the furculum for articulation with the sharply pointed carina. The tiger bitterns also form a transition to the true bitterns in the lateral position of the intramuscular line of the coracoid. This character is constant in the bitterns and occurs elsewhere in the family only in the two tiger bittern genera, and in Erythocnus, of the night heron group.

Subfamily Botaurinae, Bitterns

The subfamily Botaurinae includes the genera Botaurus and Ixobrychus. The grooved condition of the broad ventral crest of the pygostyle, separates this subfamily from the remainder of the family. In five characters the bitterns show a constantly reversed condition from the generalized condition.

The five predominantly bittern characters are:

1. Internasal septum always intermediate.
2. Hypocleidium always short, notched.
3. Articular surface of carina always sharply pointed.
4. Intramuscular line of coracoid always lateral.
5. Tendinal groove of carpometacarpus reduced except in Botaurus.

Several of these characters occur in other groups of genera among the Ardeinae, but none of them are present in the generalized line. Only two of the generalized Ardeinae characters are shared by the bitterns.

Subfamily Cochleariinae, Boat-billed Heron

Of the twelve osteological characters shown in Plate 1, the genus Cochlearius agrees most closely with the night heron group. The angulate lacrimal, short, notched hypocleidium, and lateral position of the intramuscular line of the coracoid, however, relate it also to the bitterns, as does the broad, flat, ungrooved ventral crest of the pygostyle. A combination of the external variation of the powder-downs, the structure of the bill, and consequent modification of the palate are sufficient to warrant subfamily rank within the family Ardeidae.

Generic diagnoses. Heretofore generic diagnoses in birds have been based upon external characters, and the entire internal anatomy has been largely neglected below the family level. The few workers in avian osteology have usually been concerned with charting the amount of divergence, or mapping the qualitative variations within a given group.

As has been shown in the preceding section, the family is divisible into subfamilies and tribes on the basis of osteology. It is possible to continue the classification to lower taxons on the same basis. Below are presented generic diagnoses based on osteological characters. As far as is known, this is the first attempt to treat an entire family of birds in such a manner.

In general there is a surprising amount of agreement between the conclusions reached here on the basis of comparative osteology and those arrived at earlier by other workers concerned exclusively with external characters. Certain exceptions in the current classification, however, are pointed out below. In each case it is thought that the osteological evidence for uniting certain taxons outweighs other considerations.

Family *Ardeidae*
Subfamily *Ardeinae*
Tribe *Ardeae*

1. *Ardea*: Internasal septum lacking; supraorbital vacuities always two; ectethmoid variable; lacrimal parallel (angulate and notched in *A. pacifica*); inferior process of hypocleidium truncate, superior process spatulate (short and pointed in *A. pacifica* and *A. purpurea*); articular surface of carina always broad, flat; fibula not ankylosed to fibula (ankylosed in *A. goliath* and *A. cinerea*); sternal facet of coracoid laterally placed; intramuscular line of M. supracoracoideus and M. coracobrachialis posterior medial; tendinal groove of carpometacarpus greatly enlarged; hypotarsus with one complete tendinal canal (two in *A. pacifica* and *A. purpurea*).

Pre/Sk 8.6-12.0; Pre/Post 50.7-62.2; Pre/Cr 25.9-34.1; Post/Cr 43.1-59.8; Pt/Ql 61.7-72.9; Qw/Ql 61.7-72.9; Qw/Ql 74.8-85.0; Fe/Hu 48.3-67.1; Fe/Ul 41.2-58.6; Fe/Cmc 94.7-128.2 (*A. pacifica* 85.0-87.3); Ti/Hu 110.7-136.9; Ti/Ul 92.9-116.7; Ti/Cmc 197.0-277.3; Ta/Hu 80.4-101.8; Ta/Ul 68.7-87.7; Ta/Cmc 150.1-207.8; Ha/Hu 19.7-28.3 (*A. purpurea* 32.3-33.9); Ha/Ul 16.8-29.9; Ha/Cmc 39.6-55.4; Hu/Ul 80.3-88.7; Ra/Ul 91.7-97.2; Cmc/Ul 40.2-48.7; P-1/Ul 14.2-18.4; P-2/Ul 12.1-15.4; Fe/Ti 39.3-56.8; Ta/Ti

68.6-80.8; Ha/Ti 16.3-28.9.

The genus Ardea, with the nine representative species included in this study, follows a relatively constant pattern with respect to qualitative characters (Plate 1). Variations occur in five of the twelve characters presented. On the basis of these variants, the following species are apparently more closely related to one another than to the remainder of the species:

goliath and cinerea: ankylosed tibia-fibula.
cinerea, herodias, and occidentalis: bridged ectethmoid.
pacifica and purpurea: hypotarsus with two tendinal canals.

Statistical data (Plate 2) show a different picture, however, in that only herodias and occidentalis remain difficult to separate. Means of the ratios plotted for the two forms show an amazing degree of similarity. Further, there is complete overlap in nineteen of the twenty-six ratios used in this study for herodias and occidentalis.

Mayr (1956) summarized the status of occidentalis and expresses the belief that it should be accepted only as a dimorphic subspecies of Ardea herodias.

The morphological data presented in this study substantiate the suggested subspecific rank of occidentalis. Further reference to this form will therefore be made to Ardea herodias occidentalis.

2. Butorides: Internasal septum lacking; supraorbital vacuities always two; ectethmoid separate; lacrimal angulate, notched; inferior process of hypocleidium truncate, superior process short, pointed; articular surface of carina broad, flat; fibula not ankylosed to tibia; sternal facet of coracoid lateral; intramuscular line of M. supracoracoideus and

M. coracobrachialis medial; tendinal groove of carpometacarpus enlarged; hypotarsus with one complete tendinal canal.

Pre/Sk 8.7-11.9; Pre/Post 49.1-59.6; Pre/Cr 26.1-31.6; Post/Cr 47.0-57.8; Pt/Ql 67.2-80.0; Qw/Ql 80.0-90.8; Fe/Hu 62.1-74.4; Fe/Ul 61.6-68.8; Fe/Cmc 123.6-138.1; Ti/Hu 105.5-120.3; Ti/Ul 100.5-111.5; Ti/Cmc 195.7-220.3; Ta/Hu 70.0-79.1; Ta/Ul 63.6-71.3; Ta/Cmc 128.5-143.3; Ha/Hu 27.8-34.2; Ha/Ul 25.3-29.6; Ha/Cmc 51.1-61.0; Hu/Ul 88.3-92.8; Ra/Ul 91.4-96.5; Cmc/Ul 47.4-51.6; P-1/Ul 16.0-18.6; P-2/Ul 14.5-16.5; Fe/Ti 59.6-64.4; Ta/Ti 62.2-67.6; Ha/Ti 24.1-27.9.

The genus Butorides is inseparable from the generalized ardeid form on the basis of the seven characters listed above. It differs from the general form in only one of the five other characters mentioned. In this character, the superior process of the hypocleidium, Butorides is related to Ardea pacifica and A. purpurea in having a short, pointed process.

Within the genus, the two species of Butorides are inseparable on osteological grounds, either qualitatively, or quantitatively. Thus, the two species are now referred to the species striatus, with striatus and virescens as subspecies (Linnaeus, 1758).

3. Hydranassa: Internasal septum lacking; supraorbital vacuities always two; ectethmoid separate; lacrimal angulate, notched; inferior process of hypocleidium truncate, superior process spatulate; articular surface of carina broad, flat; fibula not ankylosed to tibia; sternal facet of coracoid lateral, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior medial; tendinal groove of

carpometacarpus enlarged; hypotarsus with one complete tendinal canal.

Pre/Sk 8.2-9.2; Pre/Post 49.8-58.5; Pre/Cr 24.5-28.2; Post/Cr 44.8-52.7; Pt/Ql 71.5-79.7; Qw/Ql 87.1-95.4; Fe/Hu 57.6-60.0; Fe/Ul 48.4-51.0; Fe/Cmc 97.6-105.3; Ti/Hu 124.9-146.0; Ti/Ul 105.3-124.8; Ti/Cmc 213.5-257.6; Ta/Hu 93.3-108.3; Ta/Ul 77.9-92.1; Ta/Cmc 161.3-189.9; Ha/Hu 27.1-29.7; Ha/Ul 23.0-25.4; Ha/Cmc 47.8-52.5; Hu/Ul 82.9-85.5; Ra/Ul 94.9-96.5; Cmc/Ul 47.8-50.9; P-1/Ul 16.4-18.0; P-2/Ul 12.6-15.4; Fe/Ti 40.8-46.1; Ta/Ti 70.0-77.7; Ha/Ti 19.0-22.6.

As in Butorides, Hydranassa is related directly to the generalized ardeid form in all of the seven listed characters. Further, only one of the five other characters shows a difference from the general form. This, as in the former genus, relates to the angulate, notched lacrimal characteristic of Ardea pacifica.

4. Ardeola: Internasal septum lacking; supraorbital vacuities always two; ectethmoid separate; lacrimal angulate, notched; inferior process of hypocleidium truncate, superior process short, pointed; articular surface of carina broad, flat; fibula not ankylosed to tibia; sternal facet of coracoid lateral, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior medial; tendinal groove of carpometacarpus reduced; hypotarsus with two complete tendinal grooves.

Pre/Sk 10.7-12.2; Pre/Post 49.5-54.5; Pre/Cr 28.2-31.2; Post/Cr 54.2-58.5; Pt/Ql 65.8-83.3; Qw/Ql 81.3-86.2; Fe/Hu 65.3-69.0; Fe/Ul 56.5-62.1; Fe/Cmc 115.9-120.8 (A. speciosa 128.3, one specimen); Ti/Ul 97.9-101.6 (A. speciosa 82.2, one specimen); Ti/Cmc 193.0-213.3 (A. speciosa 169.8, one specimen); Ta/Hu 70.8-79.0; Ta/Ul 61.9-65.9 (A.

speciosa, one specimen); Ta/Cmc 119.4-147.0; Ha/Hu 27.8-30.9; Ha/Ul 24.1-27.9; Ha/Cmc 46.9-57.5; Hu/Ul 84.9-87.5 (A. speciosa 90.1, one specimen); Ra/Ul 94.3-95.3; Cmc/Ul 47.6-51.9; P-1/Ul 16.5-17.8; P-2/Ul 15.4-17.6; Fe/Ti 55.6-60.1 (A. speciosa 75.6, one specimen); Ta/Ti 61.9-66.9 (A. speciosa 86.6, one specimen); Ha/Ti 23.2-26.0 (A. speciosa 33.9, one specimen).

Ardeola agrees with the generalized ardeid form in six of the seven general characters. The three species of this genus have a much reduced tendinal groove of the carpometacarpus in contrast with the prominent groove in the generalized ardeid form. In other characters, Ardeola agrees with Butorides in having a short, pointed superior process of the hypocleidium, and an angulate, notched lacrimal. Ardeola is related to Ardea pacifica, and A. purpurea in the same manner. The species of Ardeola agree in their qualitative characters, but are separable statistically.

Tribe Egrettae

1. Casmerodius: Internasal septum intermediate; supraorbital vacuities always two; ectethmoid separate; lacrimal parallel, "I" shaped; inferior process of hypocleidium truncate, superior process spatulate; articular surface of carina broad, flat; fibula ankylosed to tibia at distal end; sternal facet of coracoid medially placed, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior medial; tendinal groove of carpometacarpus reduced; hypotarsus with one complete tendinal canal.

Pre/Sk 7.8-9.3; Pre/Post 51.8-62.6; Pre/Cr 23.0-29.0; Post/Cr

40.9-48.4; Pt/Ql 58.4-71.0; Qw/Ql 76.5-83.4; Fe/Hu 48.5-58.7; Fe/Ul 43.3-46.0; Fe/Cmc 97.6-103.1; Ti/Hu 122.7-151.5; Ti/Ul 111.4-126.4; Ti/Cmc 248.4-278.1; Ta/Hu 94.9-110.4; Ta/Ul 83.2-92.2; Ta/Cmc 187.2-207.5; Ha/Hu 23.3-27.7; Ha/Ul 19.8-21.7; Ha/Cmc 44.5-51.2; Hu/Ul 81.0-85.5; Ra/Ul 90.7-97.6; Cmc/Ul 42.3-46.2; P-1/Ul 15.0-16.5; P-2/Ul 13.2-14.2 (C. a. modestus 15.4, one specimen); Fe/Ti 35.8-39.6; Ta/Ti 71.2-77.7; Ha/Ti 16.0-19.2.

The monotypic genus Casmerodius agrees with the genus Egretta and is distinguished from the other egrets by the medial position of the sternal facet of the coracoid. It further differs from the generalized ardeid form in having the fibula ankylosed to the tibia at its distal end. The condition of the lacrimal bone of Casmerodius is unique among the herons. An anterior projection of the inferior process of the lacrimal is present which gives this bone the appearance of an "I".

2. Egretta: Internasal septum intermediate; supraorbital vacuities always two; ectethmoid separate, lacrimal angulate, notched, inferior process of hypocleidium truncate, superior process spatulate, articular surface of carina broad, flat; tibia-fibula relationship variable, ankylosed in E. intermedia, not in E. garzetta; sternal facet of coracoid medial, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior medial; tendinal groove of carpometacarpus enlarged; condition of hypotarsus variable, E. garzetta with one complete tendinal canal, E. intermedia with two complete tendinal canals.

Pre/Sk 9.6-10.8; Pre/Post 48.5-51.8; Pre/Cr 27.2-28.7; Post/Cr 54.8-56.4; Pt/Ql 63.9-73.5; Qw/Ql 83.5-88.6; Fe/Hu 53.0-60.9; Fe/Ul

44.0-52.1; Fe/Cmc 96.3-108.6; Ti/Hu 129.2-157.3; Ti/Ul 116.9-127.3; Ti/Cmc 240.7-269.6; Ta/Hu 93.6-104.1; Ta/Ul 78.9-87.6; Ta/Cmc 173.0-189.3; Ha/Hu 25.2-28.9; Ha/Ul 20.2-24.0; Ha/Cmc 44.2-52.6; Hu/Ul 75.9-87.4; Ra/Ul 95.2-96.6; Cmc/Ul 45.1-47.9; P-1/Ul 15.8-17.6; P-2/Ul 14.0-16.9; Fe/Ti 37.7-44.1; Ta/Ti 66.9-74.6; Ha/Ti 17.1-20.6.

The genus *Egretta*, with its two species, differs from *Casmerodius* in having a greatly enlarged tendinal groove of the carpometacarpus. This groove is much reduced in *Casmerodius*. Thus, *Egretta*, is similar to the ardeid form in six of the generalized characters. It is related to *Casmerodius* in all other characters except the condition of the inferior process of the lacrimal. *Egretta* has the angulate, notched inferior process of the lacrimal which is characteristic of the genus *Butorides* and *Ardea pacifica*.

3. *Bubulcus*: Internasal septum intermediate, supraorbital vacuities always two; ectethmoid separate; lacrimal angulate, notched; inferior process of hypocleidium truncate, superior process short, pointed; articular surface of carina broad, flat; fibula ankylosed to tibia at distal end; sternal facet of coracoid lateral, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior medial; tendinal groove of carpometacarpus enlarged; hypotarsus with two complete tendinal canals.

Pre/Sk 10.8-11.9; Pre/Post 43.8-47.2; Pre/Cr 25.9-29.0; Post/Cr 57.4-61.7; Pt/Ql 66.1-78.2; Qw/Ql 86.6-91.2; Fe/Hu 56.3-61.6; Fe/Ul 48.1-53.0; Fe/Cmc 106.2-115.2; Ti/Hu 122.0-137.4; Ti/Ul 105.7-108.5; Ti/Cmc 232.4-236.0; Ta/Hu 85.8-91.4; Ta/Ul 74.8-78.6; Ta/Cmc 164.3-170.9;

Ha/Hu 85.8-91.4; Ha/Ul 24.2-26.7; Ha/Cmc 53.0-58.0; Hu/Ul 85.4-87.9; Ra/Ul 95.7-96.5; Cmc/Ul 45.3-56.1; P-1/Ul 16.6-18.5; P-2/Ul 15.5-16.6; Fe/Ti 45.5-49.0; Ta/Ti 70.4-72.4; Ha/Ti 22.7-24.6.

The monotypic genus Bubulcus agrees with Leucophoyx and Florida, and differs from Casmerodius and Egretta in having a lateral position of the sternal facet of the coracoid, thus forming a group of "lesser egrets". Bubulcus is separated from Leucophoyx and Florida on the basis of the internasal septum. In Bubulcus the Septum is intermediate, but in Leucophoyx and Florida the septum is entire.

Bubulcus differs from the generalized ardeid line in one of the seven basic characters. This character, however, is considered the key character for the egret group. Bubulcus further differs from the general line in two of the other five characters, these being the angulate, notched inferior process of the lacrimal, and the fact that the fibula is ankylosed to the tibia at its distal end.

4. Leucophoyx: Internasal septum present; supraorbital vacuities always two; ectethmoid separate; lacrimal angulate, notched; inferior process of hypocleidium truncate, superior process spatulate; articular surface of carina broad, flat; fibula not ankylosed to tibia; sternal facet of coracoid lateral, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior medial; tendinal groove of carpometacarpus enlarged; hypotarsus with one complete tendinal canal.

Pre/Sk 9.2-11.1; Pre/Post 45.5-47.7; Pre/Cr 27.0-29.8; Post/Cr 55.7-60.1; Pt/Ql 66.4-81.5; Qw/Ql 82.5-89.5; Fe/Hu 55.4-60.0; Fe/Ul 46.4-50.1; Fe/Cmc 96.3-107.6; Ti/Hu 137.0-145.0; Ti/Ul 113.9-122.6;

Ti/Cmc 238.9-270.4; Ta/Hu 101.4-105.1; Ta/Ul 83.5-93.9; Ta/Cmc 177.3-206.3; Ha/Hu 23.4-29.0; Ha/Ul 21.1-24.8; Ha/Cmc 45.2-51.4; Hu/Ul 82.2-84.4; Ra/Ul 95.3-97.1; Cmc/Ul 45.3-48.4; P-1/Ul 15.7-17.0; P-2/Ul 14.3-15.6; Fe/Ti 39.2-43.2; Ta/Ti 69.9-80.2; Ha/Ti 17.6-21.2;

The genus Leucophoyx, as indicated above, shows very close relationship to Florida. On the basis of the generalized ardeid characters, these differ only in the depth of the tendinal groove of the carpometacarpus. In Leucophoyx the groove is enlarged, and in Florida it is much reduced. In other qualitative characters these two forms are identical with the exception of the condition of the hypotarsus. Leucophoyx has only one complete tendinal canal, the other two being open grooves. In Florida three complete canals are present through the roofing of the grooves.

5. Florida: Internasal septum present; supraorbital vacuities always two; ectethmoid separate; lacrimal angulate, notched; inferior process of hypocleidium truncate, superior process spatulate; articular surface of carina broad, flat; fibula not ankylosed to tibia; sternal facet of coracoid lateral, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior medial; tendinal groove of carpometacarpus reduced; hypotarsus with three complete tendinal canals.

Pre/Sk 9.1-10.7; Pre/Post 44.9-49.6; Pre/Cr 25.7-28.5; Post/Cr 55.8-61.1; Pt/Ql 70.4-79.5; Qw/Ql 83.6-89.2; Fe/Hu 56.1-59.3; Fe/Ul 47.4-50.8; Fe/Cmc 98.7-103.4; Ti/Hu 132.6-146.7; Ti/Ul 113.0-125.7; Ti/Cmc 227.3-258.8; Ta/Hu 94.9-107.6; Ta/Ul 80.7-89.5; Ta/Cmc 166.5-185.0; Ha/Hu 27.2-30.3; Ha/Ul 23.0-26.0; Ha/Cmc 47.2-54.2; Hu/Ul 82.1-

86.7; Ra/Ul 95.3-96.6; Cmc/Ul 46.6-50.6; P-1/Ul 16.7-18.7; P-2/Ul 12.3-15.6; Fe/Ti 39.4-43.4; Ta/Ti 69.5-75.6; Ha/Ti 19.1-21.4.

As indicated above, Florida caerulea is separated from Leucophoyx thula by the depth of the tendinal grooves of the carpometacarpus and the condition of the hypotarsus.

The means of five of the ratios are identical for caerulea and thula. The ranges of the remaining twenty-one ratios show almost complete overlap with the means of only two ratios being separated by more than two per cent.

On the basis of these data it becomes necessary to combine these two supposed genera. Leucophoyx Sharpe 1894 is hereby synonymized with Florida Baird 1858. Future reference will be made to the snowy egret as Florida thula, with the revised generic diagnoses for Florida as follows:

Florida: Internasal septum present; supraorbital vacuities always two; ectethmoid separate; lacrimal angulate, notched; inferior process of hypocleidium truncate, superior process spatulate; articular surface of carina broad, flat; fibula not ankylosed to tibia; sternal facet of coracoid lateral, intramuscular line medial; tendinal groove of carpometacarpus variable; hypotarsus with one or three tendinal canals.

Pre/Sk 9.1-11.1; Pre/Post 44.9-49.6; Pre/Cr 25.7-29.8; Post/Cr 55.7-61.1; Pt/Ql 66.4-81.5; Qw/Ql 82.5-89.5; Fe/Hu 55.4-60.0; Fe/Ul 46.4-50.8; Fe/Cmc 96.3-107.6; Ti/Hu 132.6-146.7; Ti/Ul 113.0-125.7; Ti/Cmc 227.3-270.4; Ta/Hu 94.9-107.6; Ta/Ul 80.7-93.9; Ta/Cmc 166.5-206.3; Ha/Hu 23.4-30.3; Ha/Ul 21.1-26.0; Ha/Cmc 45.2-54.2; Hu/Ul 82.1-86.7;

Ra/Ul 95.3-97.1; Cmc/Ul 45.3-50.6; P-1/Ul 15.7-18.7; P-2/Ul 12.3-15.6; Fe/Ti 39.2-43.4; Ta/Ti 69.5-80.2; Ha/Ti 17.6-21.4.

Tribe Nycticoraces

1. Dichromanassa: Internasal septum lacking; supraorbital vacuities always two; ectethmoid separate; lacrimal angulate, notched; inferior process of hypocleidium short, notched, superior process spatulate; articular surface of carina pointed; fibula not ankylosed to tibia; sternal facet of coracoid lateral; intramuscular line of M. supracoracoideus and M. coracobrachialis posterior medial; tendinal groove of carpometacarpus reduced; hypotarsus with two complete tendinal canals.

Pre/Sk 9.5-10.3; Pre/Post 47.5-49.8; Pre/Cr 27.3-29.1; Post/Cr 55.8-59.3; Pt/Ql 71.3-73.5; Qw/Ql 83.6-86.4; Fe/Hu 55.6-57.4; Fe/Ul 46.3-47.4; Fe/Cmc 96.4-98.2; Ti/Hu 135.9-149.8; Ti/Ul 112.6-123.1; Ti/Cmc 230.7-258.6; Ta/Hu 102.0-120.3; Ta/Ul 84.4-99.3; Ta/Cmc 175.9-206.0; Ha/Hu 22.1-23.3; Ha/Ul 18.3-19.1; Ha/Cmc 38.1-40.2; Hu/Ul 82.2-84.8; Ra/Ul 96.1-96.4; Cmc/Ul 47.6-48.4; P-1/Ul 15.6-16.4; P-2/Ul 13.4-14.4; Fe/Ti 37.6-41.8; Ta/Ti 81.7-84.5; Ha/Ti 15.5-16.6.

The night herons are divided into two divergent lines on the basis of the depth of the tendinal groove of the carpometacarpus. One line, having a reduced tendinal groove, includes Dichromanassa, Pilherodius, Syrigma, and Nyctanassa. The other line, with an enlarged tendinal groove, includes Gorsachius and Nycticorax.

Further separation of the first group is made on the basis of the internasal septum. This septum is absent in Dichromanassa, thus separating the genus from the group in the direction of the Ardeae. This genus differs from the Ardeae in three of the general characters, the condition of the hyopcleidium (short, notched), the articular surface of the carina (sharply pointed), and the condition of the tendinal groove of the carpometacarpus (reduced).

2. Pilherodius: Internasal septum present; supraorbital vacuities always two; ectethmoid bridged; lacrimal angulate, notched; inferior process of hypocleidium short, notched, superior process spatulate; articular surface of carina pointed; fibula not ankylosed to tibia; sternal facet of coracoid lateral, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior medial; tendinal groove of carpometacarpus reduced; hypotarsus with two parallel tendinal canals.

Pre/Sk 9.6-10.2; Pre/Post 45.9-49.6; Pre/Cr 26.2-28.9; Post/Cr 56.1-58.3; Pt/Ql 67.4-73.1; Qw/Ql 84.7-88.9; Fe/Hu 60.7-65.1; Fe/Ul 46.8-52.7; Fe/Cmc 102.5-110.7; Ti/Hu 136.4-139.9; Ti/Ul 106.3-110.0; Ti/Cmc 226.9-234.1; Ta/Hu 95.4-104.9; Ta/Ul 73.6-81.4; Ta/Cmc 161.1-174.9; Ha/Hu 28.5-30.3; Ha/Ul 22.0-23.5; Ha/Cmc 48.1-50.3; Hu/Ul 77.1-79.6; Ra/Ul 94.9-95.7; Cmc/Ul 45.7-47.6; P-1/Ul 16.4-17.5; P-2/Ul 13.7-14.6; Fe/Ti 44.0-47.9; Ta/Ti 69.2-75.0; Ha/Ti 20.7-22.2.

Pilherodius is related to the general night heron line as indicated above, but differs from Dichromanassa in having an entire internasal septum. This genus further differs from the Ardeae in two other generalized characters set forth for that group. Pilherodius has a short, notched hypocleidial process, and a sharply pointed articular surface of the carina. It differs from the Ardeae also in having an angulate, notched inferior process of the lacrimal, a short, pointed superior process of the hypocleidium, and two complete tendinal canals in the hypotarsus.

3. *Syrigma*: Internasal septum intermediate; supraorbital vacuities always two; ectethmoid bridged; lacrimal angulate, notched; inferior process of hypocleidium short, notched; superior process short, pointed; articular surface of carina pointed; fibula not ankylosed to tibia; sternal facet of coracoid lateral, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior medial; hypotarsus with one complete tendinal canal.

Only one specimen was available for measurement for quantitative characters:

Pre/Sk 11.3; Pre/Post 46.1; Pre/Cr 27.2; Post/Cr 59.0; Pt/Ql 72.3; Qw/Ql 94.9; Fe/Hu 54.1; Fe/Ul 45.3; Fe/Cmc 93.7; Ti/Hu 116.5; Ti/Ul 97.7; Ti/Cmc 201.9; Ta/Hu 85.1; Ta/Ul 71.3; Ta/Cmc 147.5; Ha/Hu 20.7; Ha/Ul 22.7; Ha/Cmc 46.9; Hu/Ul 83.8; Ra/Ul 95.7; Cmc/Ul 48.4; P-1/Ul 17.5; P-2/Ul 14.8; Fe/Ti 46.4; Ta/Ti 73.0; Ha/Ti 23.2.

Syrigma and *Nyctanassa* agree with *Dichromanassa* and *Pilherodius* in the characters set forth above, but differ from these in having an intermediate internasal septum. *Syrigma* differs from *Nyctanassa* in having only two supraorbital vacuities, and in a bridged ectethmoid. It further differs from the Ardeae in having a bridged ectethmoid, an angulate, notched lacrimal, and a short, pointed superior process of the hypocleidium.

4. *Nyctanassa*: Internasal septumiintermediate; supraorbital vacuities lacking; ectethmoid separate; lacrimal angulate, notched;

inferior process of hypocleidium truncate, superior process spatulate; articular surface of carina broad, flat; fibula ankylosed to tibia at distal end; sternal facet of coracoid lateral, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior medial; tendinal groove of carpometacarpus reduced; hypotarsus with one complete tendinal canal.

Pre/Sk 12.3-13.5; Pre/Post 42.6-49.4; Pre/Cr 28.1-31.6; Post/Cr 61.1-69.1; Pt/Ql 55.8-65.4; Qw/Ql 76.9-88.5; Fe/Hu 58.9-62.7; Fe/Ul 49.9-54.0; Fe/Cmc 105.9-114.1; Ti/Hu 121.4-135.9; Ti/Ul 103.5-117.1; Ti/Cmc 215.8-247.4; Ta/Hu 89.3-99.6; Ta/Ul 75.6-84.0; Ta/Cmc 159.6-177.5; Ha/Hu 20.9-23.1; Ha/Ul 18.1-20.4; Ha/Cmc 34.3-42.2; Hu/Ul 83.2-89.0; Ra/Ul 94.3-96.3; Cmc/Ul 46.5-49.0; P-1/Ul 12.9-15.9; P-2/Ul 16.2-18.4; Fe/Ti 44.1-49.7; Ta/Ti 69.0-76.8; Ha/Ti 16.5-18.9.

Nyctanassa agrees with the generalized ardeid line in the same general manner with respect to the characters set forth above but differs from Syrigma, in having no supraorbital vacuities, and in having the fibula ankylosed to the tibia at its distal end.

5. Gorsachius: Internasal septum intermediate; supraorbital vacuities two; ectethmoid separate; lacrimal angulate, notched; inferior process of hypocleidium short, notched, superior process spatulate; articular surface of carina pointed; fibula ankylosed to tibia; sternal facet of coracoid lateral, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior medial; tendinal groove of carpometacarpus enlarged; hypotarsus with two complete tendinal canals.

Only one specimen available for measurement for quantitative characters:

Pre/Sk 13.3; Pre/Post 43.1; Pre/Cr 27.1; Post/Cr 62.8; Pt/Ql 70.1; Qw/Ql 92.4; Fe/Hu 60.8; Fe/Ul 52.2; Fe/Cmc 109.2; Ti/Hu 107.4; Ti/Ul 92.1; Ti/Cmc 192.8; Ta/Hu 71.8; Ta/Ul 61.6; Ta/Cmc 128.9; Ha/Hu 22.5; Ha/Ul 19.3; Ha/Cmc 40.3; Hu/Ul 85.8; Ra/Ul 96.2; Cmc/Ul 47.8; P-1/Ul 16.6; P-2/Ul 13.3; Fe/Ti 56.6; Ta/Ti 66.9; Ha/Ti 20.9.

Gorsachius and Nycticorax differ from the above mentioned night herons in having an enlarged tendinal groove. Gorsachius differs from Nycticorax in having two supraorbital vacuities, instead of four, and in the internasal septum being intermediate instead of entire. It further differs from the generalized ardeid line in having a short, notched hypocleidial process, and in having the fibula fused to the tibia at its distal end.

6. Nycticorax: Internasal septum present, intermediate in N. caledonicus; supraorbital vacuities four, sometimes incomplete in N. caledonicus; ectethmoid bridged; lacrimal angulate, entire; inferior process of hypocleidium short, notched, superior process spatulate; articular surface of carina pointed; fibula not ankylosed in N. nycticorax, ankylosed in N. caledonicus; sternal facet of coracoid lateral, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior medial; tendinal groove of carpometacarpus enlarged; hypotarsus with one complete tendinal canal in N. nycticorax, two in N. caledonicus.

Pre/Sk 12.0-13.9; Pre/Post 43.0-53.0; Pre/Cr 29.2-32.3; Post/Cr 56.6-66.8; Pt/Ql 59.2-68.8; Qw/Ql 75.1-86.7; Fe/Hu 58.8-67.4; Fe/Ul 56.4-62.2; Fe/Cmc 112.2-125.2; Ti/Hu 96.0-114.9; Ti/Ul 95.5-103.0; Ti/Cmc

187.4-210.5; Ta/Hu 61.8-76.6; Ta/Ul 60.7-68.6; Ta/Cmc 122.5-135.9; Ha/Hu 23.0-28.2; Ha/Ul 21.3-25.6; Ha/Cmc 41.9-50.5; Hu/Ul 87.9-92.8; Ra/Ul 94.5-97.0; Cmc/Ul 46.9-54.0; P-1/Ul 15.5-19.2; P-2/Ul 13.4-16.9; Fe/Ti 57.6-62.3; Ta/Ti 61.5-67.8; Ha/Ti 21.5-25.2.

The genus *Nycticorax* is separated from *Gorsachius* as indicated above. In addition to the general night heron characters, it further differs from the generalized ardeid form in having four supraorbital vacuities, and an entire internasal septum. It differs from the general form also in having a bridged ectethmoid. The two species of *Nycticorax* agree in all qualitative characters except the condition of the tibia-fibula, *N. nycticorax* having a free fibula, *N. caledonicus* having the fibula fused to the tibia at the distal end. The hypotarsus of *N. nycticorax* has only one complete tendinal canal, while *N. caledonicus* has two such canals.

7. *Erythocnus*: Internasal septum lacking; supraorbital vacuities always two; ectethmoid separate; lacrimal angulate, notched; inferior process of hypocleidium short, notched, superior process pointed; articular surface of carina pointed; fibula not ankylosed to tibia; sternal facet of coracoid lateral, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior medial; hypotarsus with one complete tendinal canal.

Pre/Sk 11.6-12.2; Pre/Post 51.9-55.3; Pre/Cr 28.6-29.8; Post/Cr 53.8-55.2; Pt/Ql 68.3-72.8; Qw/Ql 82.4-84.5; Fe/Hu 69.2-69.8; Fe/Ul 61.8-62.4; Fe/Cmc 122.2-124.7; Ti/Hu 109.0-112.3; Ti/Ul 97.4-100.2; Ti/Cmc 194.8-198.3; Ta/Hu 70.2-72.8; Ta/Ul 63.0-65.1; Ta/Cmc 126.0-128.6;

Ha/Hu 26.6-27.7; Ha/Ul 23.8-24.5; Ha/Cmc 47.5-48.5; Hu/Ul 89.4-89.4; Ra/Ul 94.7-95.6; Cmc/Ul 50.0-50.6; P-1/Ul 16.9-17.6; P-2/Ul 15.5-15.7; Fe/Ti 61.6-64.0; Ta/Ti 63.0-64.8; Ha/Ti 24.4-24.9.

Erythocnus apparently separated from the basic night heron line shortly after its divergence from the generalized ardeid form. Such a change comes as a modification in the position of the intramuscular line of the coracoid, this being lateral in position in Erythocnus, and medial in the remaining Nycticoraces, the Egrettae, and the Ardeae. The lateral position of this line in Erythocnus corresponds with the condition in the Tigriornithes, the Cochleariinae, and the Botaurinae. Erythocnus agrees with Dichromanassa, and the generalized line in having no internasal septum. It further agrees with the Ardeae in having an enlarged tendinal groove of the carpometacarpus. It agrees with the Nycticoraces in the remaining qualitative characters.

Tribe Tigriornithes
Tiger Bitterns

1. Tigriornis: Internasal septum intermediate; supraorbital vacuities four; inferior process of ectethmoid lacking, superior process much reduced; lacrimal angulate, notched; inferior and superior processes of hypocleidium lacking, furculum prescribing a smooth curve; articular surface of carina pointed; fibula not ankylosed to tibia; sternal facet of coracoid lateral, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior lateral; tendinal groove of carpometacarpus enlarged; hypotarsus with one complete tendinal canal.

Pre/Sk 10.3-10.8; Pre/Post 52.4-56.5; Pre/Cr 27.2-29.5; Post/Cr

There is no page 58; the text is continous, but there has been an error in pagination.

51.8-52.3; Pt/Ql 76.3-80.9; Qw/Ql 81.6-84.2; Fe/Hu 80.8-81.3; Fe/Ul 69.0-71.0; Fe/Cmc 157.4-161.9; Ti/Hu 125.2-129.6; Ti/Ul 110.0-110.0; Ti/Cmc 243.9-258.1; Ta/Hu 84.0-84.3; Ta/Ul 71.6-73.8; Ta/Cmc 163.6-180.0; Ha/Hu 29.2-29.4; Ha/Ul 24.9-25.6; Ha/Cmc 56.8-58.5; Hu/Ul 84.9-87.9; Ra/Ul 94.0-94.6; Cmc/Ul 42.6-45.1; P-1/Ul 15.3-16.3; P-2/Ul 11.5-11.8; Fe/Ti 62.8-64.6; Ta/Ti 65.1-67.1; Ha/Ti 22.7-23.3.

Tigriornis differs from the Ardeae in having a complete internasal septum, four supraorbital vacuities, a complete reduction of the inferior process of the ectethmoid, an anuglate, notched lacriam, no hypocleidial process, a sharply pointed articular process of the carina, and a lateral intramuscular line of the coracoid. All these characters relate it directly to the Botaurinae. Tigriornis is separated from Tigrisoma by having four supraorbital vacuities, and an entire internasal septum.

2. Tigrisoma: Internasal septum variable, present in T. mexicana, intermediate in T. lineatum; supraorbital vacuities lacking; ectethmoid separate; lacrimal parallel; inferior process and superior process of hypocleidium lacking, furculum forming a smooth curve; articular surface of carina pointed; fibula not ankylosed to tibia; sternal facet of coracoid lateral, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior lateral; tendinal groove of carpometacarpus enlarged; hypotarsus with two complete tendinal canals.

Pre/Sk 8.7-10.5; Pre/Post 44.5-53.2; Pre/Cr 23.4-28.8; Post/Cr 50.6-57.9; Pt/Ql 67.0-75.3; Qw/Ql 81.9-92.8; Fe/Hu 66.5-77.2; Fe/Ul 58.0-67.3; Fe/Cmc 128.9-141.9; Ti/Hu 121.4-131.0; Ti/Ul 102.7-108.7;

Ti/Cmc 229.1-240.7; Ta/Hu 87.0-95.0; Ta/Ul 72.2-78.9; Ta/Cmc 159.9-174.5; Ha/Hu 25.9-30.0; Ha/Ul 21.5-25.1; Ha/Cmc 47.6-55.3; Hu/Ul 81.0-90.7; Ra/Ul 93.8-96.9; Cmc/Ul 44.3-46.0; P-1/Ul 14.7-16.4; P-2/Ul 12.0-14.1; Fe/Ti 55.1-61.2; Ta/Ti 67.8-72.5; Ha/Ti 19.8-24.0.

Tigrisoma differs from the Ardeae in the manner of Tigriornis, but with internasal septum intermediate rather than entire, and with the supraorbital vacuities absent. These two characters are also used to separate the two genera, Tigrisoma and Tigriornis, both of which show similar affinities to the Botaurinae.

Subfamily Cochleariinae
Boat-billed Heron

1. Cochlearius: Internasal septum lacking; supraorbital vacuities lacking; inferior process of ectethmoid lacking, superior process much reduced; lacrimal angulate, notched; inferior process of hypocleidium short, notched, superior process spatulate; articular surface of carina pointed; fibula not ankylosed to tibia; sternal facet of coracoid lateral, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior lateral; tendinal groove of carpometacarpus reduced; hypotarsus with one complete tendinal canal.

Pre/Sk 15.8-17.7; Pre/Post 50.7-58.4; Pre/Cr 35.2-41.0; Post/Cr 69.4-70.3; Pt/Ql 63.9-68.9; Qw/Ql 93.8-95.8; Fe/Hu 69.7-79.3; Fe/Ul 59.5-62.4; Fe/Cmc 135.1-136.9; Ti/Hu 119.9-129.5; Ti/Ul 105.8-110.6; Ti/Cmc 232.1-252.0; Ta/Hu 78.0-86.9; Ta/Ul 68.9-74.3; Ta/Cmc 151.0-168.6; Ha/Hu 27.0; Ha/Ul 23.0; Ha/Cmc 52.2; Hu/Ul 85.4-88.2; Ra/Ul 94.3-94.9; Cmc/Ul 44.1-45.6; P-1/Ul 17.1-17.5; P-2/Ul 13.9-15.5; Fe/Ti 53.8-

59.0; Ta/Ti 65.1-67.2; Ha/Ti 20.8.

In addition to the external characters of the subfamily Cochleariinae, the generic diagnosis of Cochlearius relates this genus to the Egrettae, the Nycticoraces, the Tigriornithes, to one genus of the Ardeae, and to the subfamily Botaurinae. The expanded condition of the bill, with the resultant modifications of the palate, are characteristic only of Cochlearius.

Subfamily Botaurinae
Bitterns

1. Botaurus: Internasal septum intermediate; supraorbital vacuities always two; ectethmoid separate; lacrimal angulate, notched; inferior process of hypocleidium short, notched, superior process short, pointed; articular surface of carina pointed; fibula not ankylosed to tibia; sternal facet of coracoid lateral, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior lateral; tendinal groove of carpometacarpus enlarged; hypotarsus with two complete tendinal canals, one lying postero-lateral to the other.

Pre/Sk 11.0-13.3; Pre/Post 54.5-62.9; Pre/Cr 25.9-32.8; Post/Cr 47.4-54.9; Pt/Ql 59.2-69.6; Qw/Ql 72.2-81.6; Fe/Hu 71.3-75.4; Fe/Ul 64.4-69.7; Fe/Cmc 121.0-138.4; Ti/Hu 114.3-122.5; Ti/Ul 105.1-112.7; Ti/Cmc 195.6-215.9; Ta/Hu 72.8-86.4; Ta/Ul 67.0-79.1; Ta/Cmc 133.2-151.4; Ha/Hu 27.2-34.1; Ha/Ul 24.9-31.5; Ha/Cmc 49.6-59.2; Hu/Ul 89.8-93.7; Ra/Ul 94.2-96.1; Cmc/Ul 50.0-53.2; P-1/Ul 15.1-19.1; P-2/Ul 12.4-15.2; Fe/Ti 59.6-65.4; Ta/Ti 62.9-71.3; Ha/Ti 23.7-29.5.

Botaurus agrees with the Ardeae in having two supraorbital vacuities, with the sternal facet of the coracoid lateral, and in having a greatly enlarged tendinal groove of the carpometacarpus. It differs from the Ardeae in having an intermediate internasal septum, a separated ectethmoid, an angulate, notched lacrimal, a short, notched inferior process of the hypocleidium, a short, pointed superior process of the hypocleidium, a sharply pointed articular surface of the carina, and a laterally placed intramuscular line of the coracoid.

2. *Ixobrychus*: Internasal septum intermediate; supraorbital vacuities always two; ectethmoid separate; lacrimal angulate, notched; inferior process of hypocleidium short, notched, superior process short, pointed; articular surface of carina pointed; fibula not ankylosed to tibia; sternal facet of coracoid lateral, intramuscular line of M. supracoracoideus and M. coracobrachialis posterior lateral; tendinal groove of carpometacarpus reduced; hypotarsus with two complete tendinal canals.

Pre/Sk 10.0-13.5; Pre/Post 49.7-60.3; Pre/Cr 25.5-32.3; Post/Cr 46.8-55.1; Pt/Ql 60.8-84.6; Qw/Ql 75.8-90.9; Fe/Hu 83.0-90.9; except *I. strumii* 72.7; Fe/Ul 67.4-90.0; Fe/Cmc 129.2-175.4; Ti/Hu 130.2-141.0 (*I. strumii* 111.8; and *I. involucris* 153.0); Ti/Ul 120.7-138.0, (*I. strumii* 104.6); Ta/Cmc 251.3-275.1, (*I. strumii* 198.6, and *I. cinnamomeus* 227.0); Ta/Hu 82.3-89.5, (*I. strumii* 69.7); Ta/Ul 76.3-87.9, (*I. strumii* 64.6); Ta/Cmc 167.1-175.1 (*I. strumii* 123.8, and *I. cinnamomeus* 143.4); Ha/Hu 30.5-38.7; Ha/Ul 28.2-37.5; Ha/Cmc 54.1-74.5; Hu/Ul 92.6-99.4; Ra/Ul 92.5-95.9; Cmc/Ul 49.5-53.2; P-1/Ul 16.3-18.0; P-2/Ul 13.8-16.4; Fe/Ti 62.4-66.2; Ta/Ti 62.0-66.6; Ha/Ti 25.1-28.4.

Ixobrychus agrees with the Ardeae in the same manner as *Botaurus* except that it has a reduced tendinal groove of the carpometacarpus. This character also serves to separate Ixobrychus from Botaurus. Ixobrychus differs from the Ardeae in the same manner as Botaurus with the addition of the character mentioned above.

SUMMARY

As the present classification of the avian families Ardeidae and Cochleariidae is founded primarily upon external characters and has resulted in the recognition of a large number of monotypic genera, it was thought that a study of the osteology might afford an insight into the phylogenetic relationship of the genera and species of herons.

The study is based upon 326 skeletons, representing twenty-one genera, forty species, and three additional subspecies.

Measurements of the major elements of the skeleton are given. The coefficients of variation are relatively low (averaging 3.85 per cent) compared to those exhibited by other classes of vertebrates. Ratios between skeletal elements also have a low coefficient of variation, averaging 3.25 per cent. Although there is some sexual dimorphism in linear measurements, males being slightly larger, no sexual dimorphism is shown in the ratios constructed from these measurements.

On the basis of differences shown in the conformation and configuration of the various skeletal elements, the interrelationships between the species and genera are traced. The family Ardeidae includes three subfamilies, the Ardeinae or herons, the Cochleariinae or boat-billed heron (heretofore treated as a separate family), and the Botaurinae or bitterns.

The subfamily Ardeinae is divided into four tribes, all of which are new taxons. The tribe Ardeae or typical herons contains the genera _Ardea_, _Hydranassa_, _Butorides_, and _Ardeola_. The tribe Egrettae or egrets includes the genera _Casmerodius_, _Egretta_, _Bubulcus_, and _Florida_. The

tribe Nycticoraces or night herons includes the genera Dichromanassa, Pilherodius, Syrigma, Nyctanassa, Gorsachius, Nycticorax, and Erythrocnus. The tribe Tigriornithes or tiger bitterns is comprised of the genera Tigriornis and Tigrisoma. The osteological condition in the subfamilies and tribes is illustrated by photographs.

For each genus the osteological characters are described, and mensural data and ratios are given.

The limits of the monotypic genus Florida are extended to include Leucophoyx, so that the name of the snowy egret becomes Florida thula.

The great white heron is considered a subspecies of the great blue herons, so that the name of the former becomes Ardea herodias occidentalis.

The North American green heron is treated as a subspecies of the South American and Old World green-backed heron, under the name Butorides striatus virescens.

A phylogenetic tree of the various taxons is presented.

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Table 1

Skeletal measurements (mm.)

Ardea sumatrana

Measurement	Sex	N	R	M	SD	V
Skull	?	1	227.5	227.50		
Basal Skull	?	1	226.0	226.00		
Cranium	?	1	72.6	72.60		
Postorbital	?	1	36.4	36.40		
Preorbital	?	1	20.9	20.90		
Pterygoid	?	1	13.2	13.20		
Quadrate lg	?	1	21.4	21.40		
Quadrate wd	?	1	17.4	17.40		
Humerus	?	1	179.0	179.00		
Ulna	?	1	223.0	223.00		
Radius	?	1	204.5	204.50		
Carpometacarpus	?	1	89.6	89.60		
Phalanx 1	?	1	32.6	32.60		
Phalanx 2	?	1	27.0	27.00		
Femur	?	1	111.9	111.90		
Tibia	?	1	234.0	234.00		
Tarsus	?	1	163.0	163.00		
Hallux	?	1	49.1	49.10		

Table 1 (cont.)

Skeletal measurements (mm.)

Ardea goliath

Measurement	Sex	N	R	M	SD	V
Skull	♂	1	224.0	224.00		
	♀	3	212.5-240.0	225.00		
Basal Skull	♂	1	223.5	223.50		
	♀	3	212.0-238.5	224.00		
Cranium	♂	1	79.5	79.50		
	♀	3	75.1-79.8	77.40		
Postorbital	♀	2	40.3-44.4	42.35		
Preorbital	♂	1	24.8	24.80		
	♀	3	22.0-25.3	23.60		
Pterygoid	♀	3	15.8-17.6	16.43		
Quadrate lg	♂	1	28.6	28.60		
	♀	3	26.9-27.9	27.27		
Quadrate wd	♂	1	23.2	23.20		
	♀	3	21.2-22.4	21.80		
Humerus	♂	1	206.0	206.00		
	♀	3	193.5-215.0	201.50		
Ulna	♀	2	221.5-242.5	232.00		
Radius	♂	1	224.0	224.00		
	♀	2	210.5-233.0	221.75		
Carpometacarpus	♂	1	101.8	101.80		
	♀	2	97.4-103.6	100.50		
Phalanx 1	♂	1	39.4	39.40		
	♀	3	35.1-38.0	37.03		
Phalanx 2	♂	1	31.8	31.80		
	♀	1	31.8	31.80		
Femur	♂	2	116.9-129.0	122.95		
	♀	3	113.4-125.0	119.57		
Tibia	♂	1	257.2	257.20		
	♀	2	247.0-267.0	257.00		
Tarsus	♂	1	189.5	189.50		
	♀	3	170.0-189.0	176.83		
Hallux	♀	3	52.9-58.6	55.67		

Table 1 (cont.)

Skeletal measurements (mm.)

Ardea melanocephala

Measurement	Sex	N	R	M	SD	V
Skull	♀	2	154.0-155.0	154.50		
Basal Skull	♀	2	152.2-152.5	152.50		
Cranium	♀	2	57.7-59.6	58.70		
Postorbital	♀	2	33.9-34.5	34.20		
Preorbital	♀	2	17.4-17.5	17.45		
Pterygoid	♀	2	12.2-12.5	12.35		
Quadrate lg	♀	2	10.3-19.7	19.50		
Quadrate wd	♀	2	15.4-15.7	15.55		
Humerus	♀	2	156.0-157.5	156.75		
Ulna	♀	2	182.0-185.0	183.50		
Radius	♀	2	175.0-178.5	176.50		
Carpometacarpus	♀	2	79.7-80.3	80.00		
Phalanx 1	♀	2	25.9-28.4	27.15		
Phalanx 2	♀	2	24.6-25.3	24.95		
Femur	♀	2	86.6-87.4	87.00		
Tibia	♀	2	197.198.5	197.75		
Tarsus	♀	2	143.5-146.0	144.75		
Hallux	♀	2	33.8-36.2	35.00		

Table 1 (cont.)

Skeletal measurements (mm.)

Ardea cinerea

Measurement	Sex	N	R	M	SD	V
Skull	♂	6	176.5-184.5	180.42 ±1.29	3.15 ± .91	1.76 ± .51
	♀	2	168.5-178.0	173.25		
Basal Skull	♂	6	173.0-180.0	177.50 ±1.29	3.16 ± .91	1.78 ± .51
	♀	2	166.0-177.0	171.50		
Cranium	♂	6	61.5-66.0	64.17 ± .61	1.49 ± .43	2.32 ± .67
	♀	2	65.0-66.4	65.70		
Postorbital	♂	6	32.6-35.0	34.10 ± .33	0.82 ± .24	2.40 ± .69
	♀	2	33.2-33.8	33.50		
Preorbital	♂	6	17.8-20.0	19.18 ± .36	0.87 ± .25	4.54 ±1.31
	♀	2	18.1-18.4	18.05		
Pterygoid	♂	6	12.5-14.9	13.72 ± .30	0.74 ± .21	5.39 ±1.56
	♀	2	12.9-13.7	13.30		
Quadrate lg	♂	6	20.7-21.5	21.10 ± .15	0.37 ± .11	1.75 ± .51
	♀	2	20.6-20.7	20.65		
Quadrate wd	♂	6	16.3-18.2	16.80 ± .25	0.61 ± .18	3.63 ±1.05
	♀	2	15.4-16.1	15.75		
Humerus	♂	7	168.0-183.5	176.93 ±1.96	5.20 ±1.39	2.94 ± .79
	♀	3	166.2-171.0	168.02		
Ulna	♂	6	196.5-215.0	208.58 ±2.56	6.51 ±1.88	3.12 ± .90
	♀	1	196.5	196.50		
Radius	♂	6	189.5-206.5	201.00 ±2.52	6.18 ±1.79	3.07 ± .89
	♀	1	190.0	190.00		
Carpometacarpus	♂	6	89.9-96.8	93.93 ±1.09	2.67 ± .77	2.84 ± .92
	♀	2	90.5-93.0	91.75		
Phalanx 1	♂	6	31.8-34.9	33.12 ± .40	0.98 ± .28	2.96 ± .86
	♀	2	29.7-33.0	31.35		
Phalanx 2	♂	6	27.2-29.0	28.23 ± .31	0.75 ± .22	2.66 ± .77
	♀	2	25.7-29.6	27.65		
Femur	♂	8	89.9-96.6	92.20 ± .71	2.01 ± .50	2.18 ± .55
	♀	4	83.7-89.3	86.23 ±1.34	2.68 ± .95	3.11 ±1.10
Tibia	♂	6	186.0-216.5	206.00 ±4.32	10.59 ±3.06	5.14 ±1.49
	♀	2	190.5-224.0	207.25		
Tarsus	♂	6	135.0-165.0	154.78 ±4.24	10.40 ±3.01	6.72 ±1.94
	♀	2	147.5-158.0	152.75		
Hallux	♂	6	33.4-38.4	35.95 ± .66	1.61 ± .41	4.48 ±1.29
	♀	2	33.4-38.4	35.90		

Table 1 (cont.)

Skeletal measurements (mm.)

Ardea herodias treganzai

Measurement	Sex	N	R	M	SD	V
Skull	♂	4	200.5-221.5	213.50 ±4.96	9.92 ±3.51	4.65 ±1.64
	♀	3	199.0-206.0	201.66		
Basal Skull	♂	4	197.5-219.0	210.88 ±5.04	10.07 ±3.56	4.78 ±1.69
	♀	3	196.5-203.5	199.00		
Cranium	♂	4	67.6-73.6	71.93 ±1.41	2.82 ±1.00	3.92 ±1.39
	♀	3	68.3-69.2	68.70		
Postorbital	♂	5	34.6-37.3	36.38 ± .47	1.05 ± .33	2.89 ± .81
	♀	3	34.4-35.9	35.30		
Preorbital	♂	5	19.6-21.1	20.42 ± .29	0.64 ± .13	3.13 ± .99
	♀	3	19.0-19.8	19.40		
Pterygoid	♂	5	13.2-15.4	14.50 ± .38	0.85 ± .27	5.86 ±1.85
	♀	3	13.2-15.0	14.17		
Quadrate lg	♂	5	22.4-24.2	23.38 ± .34	0.76 ± .24	3.25 ±1.03
	♀	3	22.0-22.5	22.23		
Quadrate wd	♂	5	17.7-19.8	19.16 ± .38	0.84 ± .27	4.38 ±1.39
	♀	3	17.6-18.9	18.23		
Humerus	♂	4	187.5-198.0	194.38 ±2.10	4.70 ±1.49	2.42 ± .77
	♀	1	183.50	183.50		
Ulna	♂	5	213.0-236.0	228.80 ±4.15	9.30 ±2.34	4.06 ±1.28
	♀	3	205.5-225.5	215.50		
Radius	♂	5	204.5-226.5	219.90 ±4.05	9.07 ±2.87	4.12 ±1.30
	♀	2	209.0-217.5	213.25		
Carpometacarpus	♂	5	95.8-106.9	102.86 ±1.88	4.20 ±1.33	4.08 ±1.29
	♀	3	96.9-100.1	98.00		
Phalanx 1	♂	4	36.0-39.3	38.23 ± .62	1.24 ± .44	3.24 ±1.14
	♀	3	35.3-36.53			
Phalanx 2	♂	5	29.5-33.1	31.40 ± .59	1.33 ± .42	4.24 ±1.34
	♀	2	29.9-30.5	30.20		
Femur	♂	4	98.3-106.5	104.00 ±1.94	3.88 ±1.37	3.73 ±1.32
	♀	3	98.6-99.6	99.03		
Tibia	♂	4	232.5-258.5	248.25 ±5.98	11.95 ±4.22	4.81 ±1.70
	♀	3	227.5-241.5	236.17		
Tarsus	♂	4	174.0-190.5	184.38 ±3.55	7.09 ±2.51	3.85 ±1.36
	♀	3	165.5-180.0	173.83		
Hallux	♂	5	40.9-47.0	45.18 ±1.13	2.53 ± .80	5.60 ±1.77
	♀	3	41.8-43.8	43.03		

Table 1 (cont.)

Skeletal measurements (mm.)

Ardea herodias herodias

Measurement	Sex	N	R	M	SD	V
Skull	♂	18	193.5-218.0	209.22 ±1.58	6.72 ±1.12	3.21 ± .54
	♀	14	187.0-207.0	195.42 ±1.59	5.95 ±1.12	3.04 ± .57
Basal Skull	♂	18	191.5-216.5	206.47 ±1.68	7.13 ±1.19	3.45 ± .58
	♀	14	184.5-204.5	192.93 ±1.56	5.84 ±1.10	3.03 ± .57
Cranium	♂	18	66.9-73.0	71.05 ± .37	1.55 ± .26	2.18 ± .36
	♀	14	66.8-69.7	68.01 ± .22	0.84 ± .16	1.24 ± .23
Postorbital	♂	17	34.3-37.5	36.06 ± .24	0.97 ± .17	2.69 ± .46
	♀	14	34.0-36.5	34.96 ± .25	0.93 ± .18	2.66 ± .50
Preorbital	♂	19	19.0-21.3	20.11 ± .14	0.61 ± .10	3.03 ± .49
	♀	13	18.3-20.0	19.19 ± .15	0.54 ± .11	2.81 ± .55
Pterygoid	♂	19	13.6-16.1	15.27 ± .48	2.08 ± .34	1.36 ± .22
	♀	13	13.7-15.0	14.18 ± .13	0.48 ± .09	3.39 ± .07
Quadrate lg	♂	19	21.4-24.9	23.04 ± .19	0.84 ± .14	3.65 ± .59
	♀	14	20.6-22.0	21.56 ± .23	0.85 ± .16	3.94 ± .74
Quadrate wd	♂	19	16.9-19.5	17.92 ± .43	1.89 ± .31	10.55 ±1.71
	♀	14	16.5-18.0	17.31 ± .15	0.57 ± .11	3.29 ± .62
Humerus	♂	18	188.0-200.5	194.76 ± .86	3.66 ± .61	1.88 ± .31
	♀	14	179.0-191.0	185.07 ± .98	3.66 ± .69	1.98 ± .37
Ulna	♂	19	217.5-239.0	228.63 ±1.33	5.81 ± .94	2.54 ± .41
	♀	14	211.5-228.0	218.88 ±1.08	4.03 ± .76	1.84 ± .35
Radius	♂	19	209.0-229.5	220.17 ±1.34	5.85 ± .95	2.66 ± .43
	♀	14	204.5-220.0	211.24 ±1.05	3.94 ± .74	1.87 ± .35
Carpometacarpus	♂	19	97.5-107.1	102.06 ± .63	2.75 ± .45	2.69 ± .44
	♀	14	93.5-101.6	98.02 ± .61	2.28 ± .43	2.33 ± .44
Phalanx 1	♂	19	33.4-38.5	35.39 ± .38	1.64 ± .27	4.63 ± .75
	♀	14	31.3-37.7	34.39 ± .45	1.67 ± .32	4.86 ± .92
Phalanx 2	♂	19	28.3-32.9	30.65 ± .31	1.35 ± .32	4.40 ± .71
	♀	14	27.3-29.7	28.84 ± .18	0.69 ± .13	2.39 ± .45
Femur	♂	17	97.9-109.4	104.20 ± .76	3.13 ± .54	3.00 ± .51
	♀	14	94.5-101.0	97.66 ± .53	1.98 ± .37	2.03 ± .38
Tibia	♂	19	218.5-262.5	248.61 ±2.46	10.75 ±1.75	4.32 ± .70
	♀	13	219.5-251.0	233.02 ±2.10	7.86 ±1.49	3.37 ± .64
Tarsus	♂	19	163.0-198.5	183.76 ±1.96	8.54 ±1.39	4.65 ± .75
	♀	14	162.0-188.5	172.41 ±1.86	6.96 ±1.32	4.04 ± .76
Hallux	♂	19	40.9-49.4	44.58 ± .49	2.13 ± .35	4.78 ± .78
	♀	14	40.0-43.4	41.74 ± .28	1.04 ± .20	2.49 ± .47

Table 1 (cont.)

Skeletal measurements (mm.)

Ardea occidentalis

Measurement	Sex	N	R	M	SD	V
Skull	?	2	195.0-217.0	206.00		
Basal Skull	?	2	193.0-215.0	204.00		
Cranium	?	3	68.7-74.0	72.13		
Postorbital	?	3	36.0-37.4	36.90		
Preorbital	?	3	19.0-21.4	20.17		
Pterygoid	?	3	15.7-16.2	16.03		
Quadrate lg	?	3	22.2-24.5	23.47		
Quadrate wd	?	3	17.8-18.8	18.37		
Humerus	?	3	183.5-197.0	188.83		
Ulna	?	3	214.5-226.0	218.83		
Radius	?	3	206.5-217.0	210.50		
Carpometacarpus	?	3	96.4-100.9	98.67		
Phalanx 1	?	3	32.8-35.0	34.27		
Phalanx 2	?	3	29.6-31.1	30.57		
Femur	?	3	101.1-108.0	103.43		
Tibia	?	3	220.5-243.0	228.00		
Tarsus	?	3	159.5-186.5	173.17		
Hallux	?	3	43.9-46.8	45.37		

Table 1 (cont.)

Skeletal measurements (mm.)

Ardea cocoi

Measurement	Sex	N	R	M	SD	V
Skull	?	4	196.0-211.5	205.25 ±3.36	6.71 ±2.37	3.27 ±1.16
Basal Skull	?	4	193.5-210.5	203.40 ±3.40	7.19 ±2.54	3.53 ±1.25
Cranium	?	4	69.3-72.1	70.43 ± .49	0.97 ± .34	1.38 ± .49
Postorbital	?	3	35.0-36.9	35.97		
Preorbital	?	4	20.1-24.6	21.75 ±1.03	2.06 ± .73	9.47 ±3.35
Pterygoid	?	4	14.3-14.9	14.55 ± .13	0.26 ± .09	1.79 ± .63
Quadrate lg	?	3	22.7-24.5	23.43		
Quadrate wd	?	4	17.5-18.5	18.15 ± .23	0.45 ± .16	2.48 ± .88
Humerus	?	2	180.0-198.4	189.20		
Ulna	?	3	211.8-233.0	220.10		
Radius	?	3	204.5-214.5	208.33		
Carpometacarpus	?	3	92.0-97.2	95.33		
Phalanx 1	?	2	33.5-33.8	33.65		
Phalanx 2	?	3	28.5-33.9	31.13		
Femur	♀	1	101.0	101.00		
	?	2	104.5-107.5	106.00		
Tibia	?	3	246.5-269.5	255.83		
Tarsus	?	3	182.0-202.0	191.00		
Hallux	?	3	45.0-47.5	46.63		

Table 1 (cont.)

Skeletal measurements (mm.)

Ardea pacifica

Measurement	Sex	N	R	M	SD	V
Skull	?	1	131.5	131.50		
Basal skull	?	1	129.5	129.50		
Cranium	?	2	50.9-51.8	51.40		
Postorbital	?	2	27.5-27.7	27.60		
Preorbital	?	2	14.0-14.7	14.40		
Pterygoid	?	2	10.9-11.0	11.00		
Quadrate lg	?	2	15.1-15.6	15.35		
Quadrate wd	?	2	12.8-13.2	13.00		
Humerus	?	2	136.0-149.5	142.75		
Ulna	?	2	162.0-174.5	168.25		
Radius	?	2	155.0-168.5	161.75		
Carpometacarpus	?	2	76.4-84.9	80.65		
Phalanx 1	?	2	28.0-30.7	29.35		
Phalanx 2	?	2	25.0-26.3	25.65		
Femur	?	2	66.7-72.2	69.45		
Tibia	?	2	150.5-167.5	159.00		
Tarsus	?	2	31.2-33.9	32.55		
Hallux	?	2	14.5-14.8	14.65		

Table 1 (cont.)

Skeletal measurements (mm.)

Ardea purpurea

Measurement	Sex	N	R	M	SD	V
Skull	♂	1	167.5	167.50		
Basal Skull	♂	1	167.0	167.00		
Cranium	♂	4	55.7-60.1	57.60 ± .96	1.92 ± .68	3.33 ±1.18
	♀	2	52.8-54.7	53.75		
Postorbital	♂	4	24.8-25.9	25.43 ± .11	0.22 ± .08	0.87 ± .31
	♀	2	24.5-24.6	24.55		
Preorbital	♂	4	14.4-16.0	15.40 ± .38	0.75 ± .27	4.87 ±1.72
	♀	2	14.0-15.0	14.50		
Pterygoid	♂	4	11.1-12.1	11.68 ± .16	0.32 ± .11	2.74 ± .97
	♀	2	10.5-10.8	10.65		
Quadrate lg	♂	3	17.3-18.5	17.70		
	♀	2	16.6-16.8	16.70		
Quadrate wd	♂	3	13.4-14.3	13.97		
	♀	2	13.3-13.5	13.40		
Humerus	♂	4	137.5-145.5	141.13 ±1.58	3.15 ±1.11	2.23 ± .79
	♀	2	127.5-131.5	129.50		
Ulna	♂	4	156.0-171.5	163.88 ±3.73	7.46 ±2.64	4.55 ±1.61
	♀	1	146.0	146.00		
Radius	♂	4	150.5-161.0	157.25 ±3.45	6.89 ±2.43	4.38 ±1.55
	♀	1	140.5	140.50		
Carpometacarpus	♂	4	71.3-78.0	75.30 ±1.43	2.86 ±1.01	3.80 ±1.34
	♀	2	67.7-69.9	68.80		
Phalanx 1	♂	4	26.2-27.3	26.83 ± .12	0.24 ± .08	8.95 ±3.16
	♀	2	24.0-24.6	24.30		
Phalanx 2	♂	4	18.9-25.4	21.75 ±1.35	2.69 ± .95	12.37 ±4.37
	♀	1	19.6	19.60		
Femur	♂	4	90.4-94.6	92.08 ± .81	1.62 ± .57	1.76 ± .62
	♀	2	83.4-85.5	84.45		
Tibia	♂	4	161.0-191.0	174.50 ±7.09	14.18 ±5.01	8.13 ±2.87
	♀	2	157.0-172.0	164.50		
Tarsus	♂	4	117.5-128.5	124.50 ±2.44	4.88 ±1.72	3.92 ±1.39
	♀	2	109.0-118.0	113.50		
Hallus	♂	4	45.6-47.4	46.40 ± .39	0.78 ± .28	1.68 ± .59
	♀	2	42.7-44.4	43.55		

Table 1 (cont.)

Skeletal measurements (mm.)

Pilherodius pileatus

Measurement	Sex	N	R	M	SD	V
Skull	♂	2	128.0-131.0	129.50		
	♀	2	120.0-121.0	120.50		
Basal Skull	♂	2	125.5-128.0	127.25		
	♀	2	117.5-119.0	118.25		
Cranium	♂	4	45.1-47.0	46.00 ± .42	0.83 ± .29	1.80 ± .64
	♀	2	44.9-46.1	45.50		
Postorbital	♂	4	25.6-27.0	25.25 ± .38	0.75 ± .27	2.83 ±1.00
	♀	2	25.5-26.6	26.05		
Preorbital	♂	4	12.2-13.4	12.65 ± .28	0.55 ± .19	4.35 ±1.54
	♀	2	12.3-12.6	12.45		
Pterygoid	♂	4	9.3-9.8	9.62 ± .18	0.35 ± .12	3.64 ±1.29
	♀	2	9.4-9.4	9.40		
Quadrate lg	♂	4	13.4-14.0	13.72 ± .20	0.39 ± .14	2.83 ±1.00
	♀	2	13.0-13.3	13.15		
Quadrate wd	♂	4	11.6-12.0	11.85 ± .09	0.17 ± .06	1.43 ± .51
	♀	2	11.5-11.7	11.60		
Humerus	♂	3	89.7-97.3	93.63		
	♀	2	92.4-93.7	93.05		
Ulna	♂	3	118.0-123.0	119.73		
	♀	1	121.5	121.50		
Radius	♂	3	112.0-117.7	114.17		
	♀	1	115.5	115.50		
Carpometa-carpus	♂	4	54.9-57.7	56.05 ± .63	1.25 ± .44	2.23 ± .79
	♀	2	55.0-55.5	55.25		
Phalanx 1	♂	4	19.0-20.9	20.03 ± .40	0.80 ± .28	3.99 ±1.41
	♀	2	18.9-19.9	19.85		
Phalanx 2	♂	4	15.7-17.3	16.78 ± .33	0.66 ± .23	3.93 ±1.39
	♀	2	17.1-17.2	17.15		
Femur	♂	4	58.4-62.6	60.83 ± .95	1.89 ± .67	3.11 ±1.10
	♀	2	56.9-59.2	58.05		
Tibia	♂	4	125.5-134.0	129.50 ±1.77	3.54 ±1.25	2.73 ± .96
	♀	2	119.2-136.0	127.60		
Tarsus	♂	4	94.1-97.3	95.83 ± .52	1.04 ± .37	1.09 ± .39
	♀	2	89.4-92.0	90.70		
Hallux	♂	4	26.9-27.8	27.52 ± .32	0.61 ± .22	2.22 ± .78
	♀	2	26.7-28.0	27.35		

Table 1 (cont.)

Skeletal measurements (mm.)

Butorides virescens virescens

Measurement	Sex	N	R	M	SD	V
Skull	♂	16	95.0-105.0	99.44 ±1.03	4.13 ± .73	4.15 ± .73
	♀	15	89.5-109.5	96.50 ± .86	3.35 ± .61	3.47 ± .63
Basal Skull	♂	15	93.8-102.5	97.76 ± .77	2.98 ± .54	3.04 ± .56
	♀	15	88.9-104.8	95.80 ±1.04	4.02 ± .73	4.19 ± .77
Cranium	♂	16	36.6-40.4	38.50 ± .27	1.06 ± .19	2.76 ± .49
	♀	15	36.6-40.1	38.47 ± .25	0.98 ± .18	2.55 ± .47
Postorbital	♂	16	17.8-22.4	20.45 ± .37	1.48 ± .26	7.23 ±1.28
	♀	14	19.5-21.8	21.07 ± .13	0.49 ± .09	2.31 ± .44
Preorbital	♂	16	10.3-15.0	12.51 ± .30	1.18 ± .21	9.43 ±1.67
	♀	14	10.1-11.8	10.81 ± .13	0.50 ± .09	4.63 ± .88
Pterygoid	♂	16	7.8-8.8	8.38 ± .07	0.30 ± .01	3.57 ± .63
	♀	16	7.4-9.2	8.41 ± .13	0.52 ± .09	6.21 ±1.09
Quadrate lg	♂	16	10.7-12.0	11.51 ± .10	0.38 ± .07	3.31 ± .59
	♀	17	9.8-11.9	11.17 ± .11	0.44 ± .08	3.92 ± .67
Quadrate wd	♂	16	9.3-10.5	10.03 ± .07	0.27 ± .05	2.68 ± .47
	♀	17	8.8-10.0	9.63 ± .08	0.33 ± .06	3.39 ± .58
Humerus	♂	15	65.0-77.4	69.30 ± .79	3.06 ± .56	4.41 ± .81
	♀	17	61.5-70.4	67.11 ± .65	2.67 ± .46	3.97 ± .68
Ulna	♂	15	72.5-79.6	76.27 ± .62	2.41 ± .44	3.16 ± .58
	♀	17	67.9-78.4	75.00 ± .73	2.99 ± .51	3.99 ± .68
Radius	♂	15	69.3-75.5	72.90 ± .54	2.09 ± .38	2.85 ± .52
	♀	18	64.4-74.8	71.91 ± .73	3.09 ± .52	4.30 ± .72
Carpometacarpus	♂	15	35.4-39.4	37.65 ± .37	1.44 ± .26	3.81 ± .70
	♀	18	34.1-38.9	37.40 ± .32	1.37 ± .23	3.67 ± .61
Phalanx 1	♂	16	11.6-13.9	13.13 ± .14	0.56 ± .10	4.25 ± .75
	♀	19	11.4-14.1	12.97 ± .17	0.76 ± .12	5.86 ± .95
Phalanx 2	♂	16	10.6-12.4	11.84 ± .12	0.47 ± .08	4.00 ± .71
	♀	18	10.9-12.7	11.64 ± .14	0.61 ± .10	5.28 ± .88
Femur	♂	16	46.4-52.0	49.25 ± .42	1.68 ± .30	3.41 ± .60
	♀	15	43.5-50.6	48.50 ± .46	1.79 ± .33	3.69 ± .67
Tibia	♂	14	76.9-84.4	80.10 ± .73	2.73 ± .52	3.40 ± .64
	♀	13	70.4-83.2	79.14 ± .81	2.92 ± .57	3.68 ± .72
Tarsus	♂	16	47.9-54.9	52.00 ± .46	1.84 ± .33	3.53 ± .63
	♀	18	45.3-54.9	50.73 ± .50	2.11 ± .35	4.16 ± .69
Hallux	♂	16	20.2-23.0	21.30 ± .20	0.79 ± .14	3.73 ± .66
	♀	19	18.8-22.5	21.25 ± .17	0.76 ± .12	3.57 ± .57

Table 1 (cont.)

Skeletal measurements (mm.)

Butorides striatus

Measurement	Sex	N	R	M	SD	V
Skull	♀	1	100.6	100.60		
	?	3	96.9-104.7	99.77		
Basal Skull	♀	1	100.2	100.20		
	?	2	96.0-96.7	96.35		
Cranium	♀	1	37.5	37.50		
	?	3	37.5-39.5	38.33		
Postorbital	♀	1	21.1	21.10		
	?	3	20.3-21.2	20.80		
Preorbital	♀	1	11.6	11.60		
	?	3	10.7-11.5	11.10		
Pterygoid	♀	1	9.0	9.00		
	?	4	8.1-9.2	8.63		
Quadrate lg	♀	1	12.0	12.00		
	?	3	11.3-12.0	11.60		
Quadrate wd	♀	1	9.6	9.60		
	?	3	9.4-9.7	9.57		
Humerus	♀	1	69.0	69.00		
	?	3	65.6-70.8	67.67		
Ulna	♀	1	76.0	76.00		
	?	3	71.9-77.0	73.77		
Radius	♀	1	72.3	72.30		
	?	3	68.4-74.1	70.63		
Carpometacarpus	♀	1	37.6	37.60		
	?	3	35.8-36.5	36.13		
Phalanx 1	♀	1	12.5	12.50		
	?	3	13.0-13.7	13.23		
Phalanx 2	♀	1	11.1	11.10		
	?	3	11.3-11.6	11.50		
Femur	♀	1	48.9	48.90		
	?	2	48.8-49.4	49.10		
Tibia	♀	1	73.6	73.60		
	?	4	75.0-79.0	76.80 ± .89	1.77 ± .63	2.30 ± .81
Tarsus	♀	1	48.3	48.30		
	?	4	47.7-51.3	49.35 ± .84	1.67 ± .59	3.38 ±1.19
Hallux	♀	1	19.2	19.20		
	?	4	20.0-21.6	20.93 ± .29	0.57 ± .20	2.72 ± .96

Table 1 (cont.)

Skeletal measurements (mm.)

Erythocnus rufiventris

Measurement	Sex	N	R	M	SD	V
Skull	?	3	92.4-97.6	95.23		
Basal Skull						
Cranium	?	3	37.7-40.3	38.93		
Postorbital	?	3	20.5-21.7	21.20		
Preorbital	?	3	11.1-12.0	11.40		
Pterygoid	?	3	7.7-9.1	8.33		
Quadrate lg	?	3	11.0-12.5	11.83		
Quadrate wd	?	3	9.3-10.3	9.87		
Humerus	?	3	74.7-82.4	77.63		
Ulna	?	2	83.6-92.2	87.90		
Radius	?	2	79.9-87.3	83.60		
Carpometacarpus	?	2	42.3-46.7	44.20		
Phalanx 1	?	3	14.7-15.6	15.07		
Phalanx 2	?	3	13.1-14.3	13.83		
Femur	?	3	51.7-57.5	53.97		
Tibia	?	3	83.9-89.8	86.03		
Tarsus	?	3	53.2-58.1	55.23		
Hallux	?	3	20.5-21.9	21.13		

Table 1 (cont.)

Skeletal measurements (mm.)

Florida caerulea

Measurement	Sex	N	R	M	SD	V
Skull	♂	8	112.3-122.0	116.94 ±1.22	3.46 ± .87	2.96 ± .40
	♀	8	107.5-117.7	113.03 ±1.15	3.25 ± .81	2.88 ± .72
Basal Skull	♂	8	110.0-119.0	114.28 ±1.11	3.13 ± .78	2.74 ± .69
	♀	8	104.7-115.9	110.53 ±1.28	3.62 ± .91	3.28 ± .82
Cranium	♂	8	43.0-44.5	43.55 ± .92	2.59 ± .65	5.95 ±1.49
	♀	8	41.1-44.3	42.26 ± .44	1.24 ± .31	2.93 ± .73
Postorbital	♂	8	22.4-25.2	24.90 ± .14	0.41 ± .10	5.86 ±1.47
	♀	8	23.7-25.3	24.48 ± .14	0.40 ± .10	1.63 ± .41
Preorbital	♂	8	12.2-17.9	12.02 ± .13	0.36 ± .09	3.00 ± .75
	♀	8	10.8-11.9	11.49 ± .14	0.39 ± .10	3.39 ± .85
Pterygoid	♂	8	8.8-9.8	9.11 ± .14	0.41 ± .10	4.50 ±1.13
	♀	8	8.2-9.2	8.61 ± .13	0.36 ± .09	4.18 ±1.05
Quadrate lg	♂	8	11.9-13.0	12.25 ± .12	0.33 ± .08	2.69 ± .67
	♀	8	11.4-12.3	11.80 ± .11	0.32 ± .08	2.71 ± .68
Quadrate wd	♂	8	10.3-10.9	10.56 ± .09	0.26 ± .07	2.46 ± .62
	♀	8	9.8-10.6	10.28 ± .06	0.17 ± .04	1.65 ± .41
Humerus	♂	8	92.1-100.2	96.59 ± .10	2.81 ± .07	2.91 ± .73
	♀	8	90.0-96.4	93.06 ± .83	2.35 ± .59	2.53 ± .63
Ulna	♂	8	107.4-118.5	113.94 ±1.31	3.72 ± .93	3.26 ± .82
	♀	8	104.2-115.3	109.76 ±1.35	3.83 ± .96	3.49 ± .87
Radius	♂	8	103.2-113.5	109.26 ±1.25	3.53 ± .88	3.23 ± .81
	♀	8	99.6-110.4	105.10 ±1.24	3.51 ± .88	3.34 ± .84
Carpometa carpus	♂	8	53.6-57.3	55.09 ± .49	1.40 ± .35	2.54 ± .64
	♀	8	50.5-56.1	53.18 ± .70	1.99 ± .50	3.74 ± .94
Phalanx 1	♂	8	18.4-21.2	20.33 ± .31	0.88 ± .22	4.33 ±1.08
	♀	8	18.9-20.6	19.48 ± .22	0.62 ± .16	3.18 ± .80
Phalanx 2	♂	8	13.9-17.2	14.90 ± .36	1.01 ± .25	6.78 ± .69
	♀	8	13.2-14.9	14.05 ± .22	0.61 ± .15	4.34 ±1.09
Femur	♂	8	53.2-57.3	55.63 ± .48	1.36 ± .34	2.44 ± .61
	♀	8	50.8-56.6	53.58 ± .71	2.00 ± .50	3.75 ± .94
Tibia	♂	8	129.5-142.0	136.06 ±1.52	4.30 ±1.08	3.16 ± .79
	♀	8	120.5-138.8	129.30 ±2.37	6.71 ±1.68	5.19 ±1.30
Tarsus	♂	8	95.4-105.6	100.31 ±1.33	3.75 ± .94	3.74 ± .94
	♀	8	86.0-101.8	93.54 ±2.06	5.84 ±1.46	6.24 ±1.56
Hallux	♂	8	27.1-28.5	27.79 ± .52	1.47 ± .37	5.29 ±1.32
	♀	8	24.6-28.5	26.83 ± .46	1.29 ± .32	4.81 ±1.20

Table 1 (cont.)

Skeletal measurements (mm.)

Ardeola ralloides

Measurement	Sex	N	R	M	SD	V
Skull	?	2	100.7-107.4	104.40		
Basal Skull	?	2	100.0-107.0	103.50		
Cranium	?	2	38.3-39.4	38.90		
Postorbital	?	2	20.8-21.6	20.25		
Preorbital	?	2	10.8-11.5	11.20		
Pterygoid	?	2	8.1-9.5	8.80		
Quadrate lg	?	2	11.3-11.4	11.35		
Quadrate wd	?	2	9.6-9.7	9.65		
Humerus	?	2	78.1-80.7	79.40		
Ulna	?	2	90.3-92.6	91.45		
Radius	?	2	86.1-87.9	87.00		
Carpometacarpus	?	2	43.0-44.7	43.85		
Phalanx 1	?	2	14.9-16.5	15.70		
Phalanx 2	?	2	13.9-15.0	14.45		
Femur	?	2	51.0-54.0	52.50		
Tibia	?	2	91.7-93.0	92.35		
Tarsus	?	2	59.5-59.6	59.55		
Hallux	?	2	21.3-24.2	22.75		

Table 1 (cont.)

Skeletal measurements (mm.)

__Ardeola__ __bacchus__

Measurement	Sex	N	R	M	SD	V
Skull	♀	1	95.5	95.50		
	?	1	95.5	95.50		
Basal Skull	♀	1	94.5	94.50		
	?	1	94.8	94.80		
Cranium	♀	1	36.9	36.90		
	?	1	39.3	39.30		
Postorbital	♀	1	21.4	21.40		
	?	1	21.3	21.30		
Preorbital	♀	1	11.5	11.50		
	?	1	11.6	11.60		
Pterygoid	♀	1	7.9	7.90		
Quadrate lg	♀	1	10.9	10.90		
	?	1	12.3	12.30		
Quadrate wd	♀	1	9.4	9.40		
	?	1	10.0	10.00		
Humerus	♀	1	74.1	74.10		
	?	1	77.3	77.30		
Ulna	♀	1	87.3	87.30		
	?	1	88.3	88.30		
Radius	♀	1	82.6	82.60		
Carpometacarpus	♀	1	42.0	42.00		
	?	1	45.8	45.80		
Phalanx 1	♀	1	14.6	14.60		
	?	1	15.2	15.20		
Phalanx 2	♀	1	14.4	14.40		
	?	1	15.5	15.50		
Femur	♀	1	49.4	49.40		
	?	1	53.1	53.10		
Tibia	♀	1	85.5	85.50		
	?	1	88.4	88.40		
Tarsus	♀	1	57.2	57.20		
	?	1	54.7	54.70		
Hallux	♀	1	21.0	21.00		
	?	1	21.5	21.50		

Table 1 (cont.)

Skeletal measurements (mm.)

Ardeola speciosa

Measurement	Sex	N	R	M	SD	V
Skull	♂	1	94.3	94.30		
Basal Skull	♂	1	93.5	93.50		
Cranium	♂	1	36.6	36.60		
Postorbital	♂	1	21.4	21.40		
Preorbital	♂	1	10.6	10.60		
Pterygoid	♂	1	7.7	7.70		
Quadrate lg	♂	1	11.7	11.70		
Quadrate wd	♂	1	9.6	9.60		
Humerus	♂	1	74.4	74.40		
Ulna	♂	1	82.6	82.60		
Radius	♂	1	77.9	77.90		
Carpometacarpus	♂	1	40.0	40.00		
Phalanx 1	♂	1	14.3	14.30		
Phalanx 2	♂	1	14.2	14.20		
Femur	♂	1	51.3	51.30		
Tibia	♂	1	67.9	67.90		
Tarsus	♂	1	58.8	58.80		
Hallux	♂	1	23.0	23.00		

Table 1 (cont.)

Skeletal measurements (mm.)

Bubulcus ibis

Measurement	Sex	N	R	M	SD	V
Skull	♀	5	93.2-103.7	97.22 ±1.83	4.11 ±1.30	4.23 ±1.34
Basal Skull	♂	1	95.3	95.30		
	♀	4	92.4-102.6	96.48 ±2.14	4.27 ±1.51	4.43 ±1.57
Cranium	♀	5	38.9-40.9	39.86 ± .33	0.75 ± .24	1.88 ± .59
Postorbital	♀	5	23.0-24.6	23.86 ± .35	0.78 ± .25	3.27 ±1.03
Preorbital	♂	1	11.0	11.00		
	♀	5	10.2-11.6	10.92 ± .28	0.62 ± .20	5.68 ±1.80
Pterygoid	♂	1	8.4	8.40		
	♀	5	8.3-9.3	8.70 ± .18	0.41 ± .13	4.71 ±1.49
Quadrate lg	♂	1	12.7	12.70		
	♀	5	11.2-12.1	11.66 ± .16	0.36 ± .11	3.09 ± .98
Quadrate wd	♂	1	11.0	11.00		
	♀	5	10.0-10.8	10.46 ± .13	0.30 ± .09	2.87 ± .91
Humerus	♂	1	91.9	91.90		
	♀	4	85.6-89.9	88.20 ±1.00	1.99 ± .70	2.26 ± .80
Ulna	♂	1	105.2	105.20		
	♀	4	99.3-104.6	102.13 ±1.02	2.04 ± .72	2.00 ± .71
Radius	♂	1	100.9	100.90		
	♀	4	95.3-100.9	98.10 ±1.15	2.29 ± .81	2.33 ± .82
Carpometacarpus	♂	1	48.5	48.50		
	♀	4	45.7-48.1	46.78 ± .41	0.82 ± .29	1.75 ± .62
Phalanx 1	♂	1	18.3	18.30		
	♀	4	17.4-18.9	17.83 ± .38	0.75 ± .27	4.21 ±1.49
Phalanx 2	♂	1	17.2	17.20		
	♀	4	16.2-16.6	16.37 ± .20	0.39 ± .14	2.38 ± .84
Femur	♂	1	53.2	53.20		
	♀	5	49.4-56.0	52.88 ±1.36	3.04 ± .96	5.75 ±1.82
Tibia	♂	1	112.7	112.70		
	♀	4	106.7-123.5	112.02 ±3.89	7.78 ±2.75	6.95 ±2.46
Tarsus	♂	1	80.1	80.10		
	♀	4	76.8-87.2	79.53 ±2.54	5.07 ±1.79	6.37 ±2.25
Hallux	♂	1	25.7	25.70		
	♀	4	24.2-27.9	25.75 ± .80	1.60 ± .57	6.21 ±2.19

Table 1 (cont.)

Skeletal measurements (mm.)

Dichromanassa rufescens

Measurement	Sex	N	R	M	SD	V
Skull	♂	2	147.5-149.5	148.50		
	♀	1	138.5	138.50		
Basal Skull	♂	2	144.5-147.5	146.00		
	♀	1	135.5	135.50		
Cranium	♂	3	50.4-52.3	51.57		
	♀	2	49.9-52.0	50.95		
Postorbital	♂	3	28.1-31.0	29.60		
	♀	2	27.9-30.5	29.20		
Preorbital	♂	3	14.0-15.2	14.67		
	♀	2	13.6-14.5	14.05		
Pterygoid	♂	2	10.7-10.7	10.70		
	♀	2	10.2-10.8	10.50		
Quadrate lg	♂	3	14.6-14.8	14.70		
	♀	2	13.9-14.7	14.30		
Quadrate wd	♂	3	12.2-12.6	12.47		
	♀	2	11.9-12.7	12.30		
Humerus	♂	3	118.5-125.5	122.83		
	♀	2	115.5-128.5	122.00		
Ulna	♂	3	143.0-152.0	148.50		
	♀	2	140.5-151.5	146.00		
Radius	♂	2	137.5-146.5	142.00		
	♀	2	135.0-146.0	140.50		
Carpometacarpus	♂	3	69.8-73.3	71.77		
	♀	2	66.9-73.3	70.10		
Phalanx 1	♂	3	23.3-24.6	23.87		
	♀	2	22.3-24.9	23.60		
Phalanx 2	♂	3	20.2-21.3	20.90		
	♀	2	20.2-20.3	20.25		
Femur	♂	2	67.3-72.0	69.25		
	♀	2	65.0-71.4	68.20		
Tibia	♂	3	161.0-184.9	173.47		
	♀	2	173.0-178.0	175.50		
Tarsus	♂	3	127.0-151.0	138.00		
	♀	1	145.5	145.50		
Hallux	♂	3	26.7-29.0	27.73		
	♀	2	26.9-28.6	27.75		

Table 1 (cont.)

Skeletal measurements (mm.)

Casmerodius albus modestus

Measurement	Sex	N	R	M	SD	V
Skull	♀	1	153.0	153.00		
Basal skull	♀	1	151.0	151.00		
Cranium	♀	1	51.9	51.90		
Postorbital	♀	1	25.1	25.10		
Preorbital	♀	1	13.4	13.40		
Pterygoid	♀	1	9.4	9.40		
Quadrate lg	♀	1	16.1	16.10		
Quadrate wd	♀	1	12.4	12.40		
Humerus	♀	1	135.0	135.00		
Ulna	♀	1	159.5	159.50		
Radius	♀	1	153.5	153.50		
Carpometacarpus	♀	1	71.3	71.30		
Phalanx 1	♀	1	26.3	26.30		
Phalanx 2	♀	1	24.6	24.60		
Femur	♀	1	71.5	71.50		
Tibia	♀	1	182.0	182.00		
Tarsus	♀	1	141.5	141.50		
Hallux	♀	1	34.3	34.30		

Table 1 (cont.)

Skeletal measurements (mm.)

Casmerodius albus egretta

Measurement	Sex	N	R	M	SD	V
Skull	♂	11	158.0-177.5	169.87 ±1.52	5.04 ±1.08	2.97 ± .63
	♀	9	155.0-173.5	165.89 ±1.65	4.95 ±1.17	2.98 ± .70
Basal Skull	♂	11	155.0-175.0	168.23 ±1.34	4.45 ± .95	2.65 ± .56
	♀	9	152.5-171.3	162.94 ±1.83	5.50 ±1.30	3.37 ± .79
Cranium	♂	11	53.1-58.7	56.66 ± .48	1.58 ± .34	2.79 ± .59
	♀	9	53.1-58.9	55.39 ± .46	1.37 ± .32	2.48 ± .58
Postorbital	♂	11	23.9-26.3	24.96 ± .24	0.78 ± .17	3.13 ± .67
	♀	9	24.1-25.0	24.66 ± .13	0.39 ± .09	1.56 ± .37
Preorbital	♂	11	12.8-15.1	14.23 ± .19	0.62 ± .13	4.34 ± .93
	♀	9	13.0-15.4	14.57 ± .24	0.72 ± .17	4.93 ±1.16
Pterygoid	♂	11	9.6-11.2	10.67 ± .12	0.39 ± .08	3.62 ± .77
	♀	9	9.8-11.2	10.47 ± .14	0.42 ± .10	3.97 ± .94
Quadrate lg	♂	11	15.5-17.1	16.49 ± .17	0.57 ± .12	3.45 ± .74
	♀	9	15.5-17.5	16.19 ± .22	0.66 ± .16	4.06 ± .96
Quadrate wd	♂	11	12.3-13.6	12.95 ± .10	0.34 ± .07	2.61 ± .56
	♀	9	12.1-14.4	12.78 ± .24	0.71 ± .17	5.53 ±1.30
Humerus	♂	11	140.5-158.5	150.69 ±1.26	4.17 ± .89	2.76 ± .59
	♀	9	141.5-157.0	146.64 ±1.39	4.16 ± .98	2.83 ± .67
Ulna	♂	9	177.5-191.0	182.32 ±1.57	4.71 ±1.11	2.59 ± .61
	♀	9	162.5-187.5	173.61 ±2.46	7.37 ±1.74	4.25 ±1.00
Radius	♂	11	162.0-184.0	174.96 ±1.50	4.98 ±1.06	2.85 ± .61
	♀	9	156.5-179.5	167.50 ±2.22	6.67 ±1.57	3.98 ± .94
Carpometa-carpus	♂	11	73.3-86.3	80.23 ± .98	3.25 ± .69	4.05 ± .86
	♀	8	72.9-83.6	77.25 ±1.40	3.95 ± .99	5.12 ±1.28
Phalanx 1	♂	11	25.4-29.9	28.00 ± .39	1.28 ± .27	4.57 ± .98
	♀	9	25.9-29.3	27.06 ± .64	1.92 ± .45	7.09 ±1.67
Phalanx 2	♂	11	22.8-27.2	25.10 ± .32	1.04 ± .22	4.16 ± .89
	♀	9	22.7-26.1	23.94 ± .63	1.89 ± .44	7.88 ±1.86
Femur	♂	11	74.7-84.5	82.05 ± .93	3.09 ± .66	3.76 ± .80
	♀	10	71.6-85.3	77.40 ±1.41	4.46 ±1.00	5.76 ±1.29
Tibia	♂	11	193.0-226.5	213.69 ±2.08	6.91 ±1.47	3.24 ± .69
	♀	8	181.0-232.5	206.25 ±4.40	12.44 ±3.11	6.03 ±1.51
Tarsus	♂	11	139.0-170.5	162.36 ±2.38	7.90 ±1.68	4.87 ±1.04
	♀	9	140.0-169.5	150.66 ±2.77	8.31 ±1.96	5.52 ±1.30
Hallux	♂	11	34.7-43.5	38.42 ± .60	1.99 ± .43	5.19 ±1.11
	♀	9	34.3-40.7	36.42 ± .70	2.10 ± .49	5.75 ±1.36

Table 1 (cont.)

Skeletal measurements (mm.)

Egretta garzetta

Measurement	Sex	N	R	M	SD	V
Skull	♂	1	114.9	114.90		
	♀	2	116.8-118.8	117.80		
Basal Skull	♂	1	111.9	111.90		
	♀	2	114.8-117.3	116.05		
Cranium	♂	1	40.3	40.30		
	♀	2	41.1-41.9	41.50		
Postorbital	♂	1	22.7	22.70		
	♀	3	23.2-23.4	23.30		
Preorbital	♂	1	11.0	11.00		
	♀	3	11.4-11.9	11.70		
Pterygoid	♂	1	8.3	8.30		
	♀	3	7.9-8.8	8.33		
Quadrate lg	♂	1	11.3	11.30		
	♀	3	11.4-12.0	11.70		
Quadrate wd	♂	1	9.8	9.80		
	♀	3	10.1-10.4	10.23		
Humerus	♂	2	93.7-99.4	96.55		
	♀	4	95.5-104.1	97.73 ±2.09	4.17 ±1.47	4.27 ±1.51
Ulna	♂	2	107.2-131.0	119.10		
	♀	3	113.6-126.0	118.03		
Radius	♂	2	103.5-126.5	115.00		
	♀	3	108.4-120.0	112.63		
Carpometacarpus	♂	2	51.4-59.7	55.55		
	♀	3	51.3-58.4	53.77		
Phalanx 1	♂	1	18.9	18.90		
	♀	3	18.7-20.5	19.47		
Phalanx 2	♂	1	18.1	18.10		
	♀	3	17.2-19.2	17.93		
Femur	♂	3	55.8-60.5	58.63		
	♀	4	53.0-59.4	55.13 ±1.43	2.85 ±1.01	5.17 ±1.83
Tibia	♂	2	116.5-154.5	135.50		
	♀	2	123.5-157.5	140.50		
Tarsus	♂	2	83.0-103.3	93.15		
	♀	3	92.1-110.4	99.23		
Hallux	♂	2	25.3-26.4	25.85		
	♀	3	24.1-26.9	25.10		

Table 1 (cont.)

Skeletal measurements (mm.)

Egretta intermedia

Measurement	Sex	N	R	M	SD	V
Skull	♂	1	121.5	121.50		
Basal Skull	♂	1	119.0	119.00		
Cranium	♂	1	46.2	46.20		
Postorbital	♂	1	25.3	25.30		
Preorbital	♂	1	13.1	13.10		
Pterygoid	♂	1	8.5	8.50		
Quadrate lg	♂	1	13.3	13.30		
Quadrate wd	♂	1	11.1	11.10		
Humerus	♂	1	113.5	113.50		
Ulna	♂	1	136.5	136.50		
Radius	♂	1	131.0	131.00		
Carpometacarpus	♂	1	62.4	62.40		
Phalanx 1	♂	1	21.5	21.50		
Phalanx 1	♂	1	19.1	19.10		
Femur	♂	1	60.1	60.10		
Tibia	♂	1	159.5	159.50		
Tarsus	♂	1	118.1	118.10		
Hallux	♂	1	32.8	32.80		

Table 1 (cont.)

Skeletal measurements (mm.)

Leucophoyx thula

Measurement	Sex	N	R	M	SD	V
Skull	♂	9	106.7-124.5	116.48 ±1.88	5.65 ±1.33	4.85 ±1.14
	♀	3	111.8-114.0	113.10		
Basal Skull	♂	9	104.7-122.5	113.82 ±1.81	5.42 ±1.28	4.76 ±1.12
	♀	3	109.4-111.8	110.93		
Cranium	♂	9	40.0-42.5	41.13 ± .32	0.95 ± .22	2.31 ± .54
	♀	3	38.6-40.0	39.40		
Postorbital	♂	9	23.3-24.6	23.78 ± .12	0.35 ± .08	1.47 ± .35
	♀	3	23.1-23.6	23.40		
Preorbital	♂	9	10.9-12.3	11.63 ± .16	0.47 ± .11	4.04 ± .95
	♀	3	10.7-10.8	10.73		
Pterygoid	♂	9	7.7-9.7	8.78 ± .17	0.50 ± .12	5.69 ±1.34
	♀	3	7.9-8.3	8.07		
Quadrate lg	♂	9	11.0-11.9	11.41 ± .28	0.85 ± .20	7.45 ±1.76
	♀	3	10.8-11.0	10.87		
Quadrate wd	♂	9	9.4-10.2	9.84 ± .11	0.33 ± .08	3.35 ± .79
	♀	3	9.3-9.4	9.33		
Humerus	♂	8	92.0-101.8	96.00 ± .79	2.24 ± .56	2.33 ± .58
	♀	5	88.8-97.1	93.30 ±1.64	3.67 ±1.16	3.93 ±1.24
Ulna	♂	9	107.5-121.5	115.16 ±1.08	3.25 ± .77	2.82 ± .66
	♀	3	107.1-110.7	109.43		
Radius	♂	9	103.2-118.0	111.36 ±1.40	4.19 ± .99	3.76 ± .89
	♀	5	102.8-113.2	108.20 ±2.12	4.74 ±1.50	4.38 ±1.39
Carpometacarpus	♂	9	51.4-58.6	54.42 ± .78	2.34 ± .55	4.30 ±1.01
	♀	3	50.4-51.9	51.40		
Phalanx 1	♂	9	17.3-20.1	18.77 ± .27	0.81 ± .19	4.31 ±1.02
	♀	3	18.0-18.1	18.03		
Phalanx 2	♂	9	16.7-18.0	17.32 ± .14	0.43 ± .10	2.48 ± .58
	♀	3	16.1-16.5	16.33		
Femur	♂	9	51.2-58.4	55.42 ± .66	1.97 ± .47	3.56 ± .84
	♀	5	52.8-55.1	53.84 ± .50	1.12 ± .35	2.08 ± .66
Tibia	♂	9	126.0-141.5	136.50 ±1.70	5.10 ±1.20	3.74 ± .88
	♀	3	123.5-126.5	125.50		
Tarsus	♂	8	95.7-107.9	101.50 ±1.23	3.67 ± .87	3.62 ± .85
	♀	3	91.0-93.5	92.63		
Hallux	♂	9	24.5-26.9	25.88 ± .26	0.78 ± .18	3.02 ± .71
	♀	3	24.3-24.5	24.40		

Table 1 (cont.)

Skeletal measurements (mm.)

Hydranassa tricolor ruficolis

Measurement	Sex	N	R	M	SD	V
Skull	♂	9	125.6-144.5	135.50 ±1.92	5.77 ±1.36	4.26 ±1.00
	♀	5	126.8-134.0	130.96 ±1.24	2.78 ± .88	2.12 ± .67
Basal Skull	♂	9	124.2-141.9	133.50 ±1.92	5.77 ±1.36	4.32 ±1.02
	♀	5	126.3-131.5	129.42 ±1.16	2.59 ± .82	2.00 ± .63
Cranium	♂	10	42.8-46.0	44.10 ± .41	1.28 ± .29	2.90 ± .65
	♀	5	42.1-43.6	42.94 ± .29	0.65 ± .21	1.51 ± .48
Postorbital	♂	11	19.4-22.6	21.39 ± .28	0.92 ± .20	4.28 ± .91
	♀	5	20.9-22.2	21.38 ± .25	0.55 ± .17	2.57 ± .81
Preorbital	♂	11	11.3-12.7	12.03 ± .12	0.41 ± .09	3.37 ± .72
	♀	5	10.6-11.8	11.44 ± .23	0.52 ± .16	4.55 ±1.44
Pterygoid	♂	9	8.4-9.4	8.86 ± .08	0.25 ± .06	2.81 ± .66
	♀	5	8.1-8.4	8.24 ± .05	0.11 ± .03	1.33 ± .42
Quadrate lg	♂	11	11.4-12.3	11.68 ± .09	0.30 ± .06	2.56 ± .55
	♀	5	10.9-11.7	11.14 ± .16	0.36 ± .11	3.23 ±1.02
Quadrate wd	♂	11	10.1-11.4	10.85 ± .09	0.31 ± .07	2.88 ± .61
	♀	5	9.5-10.4	10.16 ± .17	0.39 ± .12	3.84 ±1.22
Humerus	♂	11	92.5-100.6	96.48 ± .74	2.46 ± .53	2.55 ± .54
	♀	6	88.7-91.7	90.13 ± .60	1.53 ± .44	1.70 ± .49
Ulna	♂	10	108.2-119.5	114.50 ±1.04	3.29 ± .74	2.87 ± .64
	♀	5	105.1-109.2	107.30 ± .89	2.00 ± .63	1.86 ± .59
Radius	♂	10	104.0-115.0	109.50 ±1.04	3.29 ± .74	3.00 ± .67
	♀	6	100.5-103.7	102.13 ± .71	1.81 ± .52	1.77 ± .51
Carpometacarpus	♂	11	52.4-60.1	56.14 ± .17	0.56 ± .13	0.99 ± .22
	♀	5	51.7-53.0	52.34 ± .26	0.58 ± .18	1.11 ± .35
Phalanx 1	♂	11	18.9-21.0	20.11 ± .20	0.66 ± .15	3.27 ± .73
	♀	5	17.7-19.6	18.78 ± .66	1.48 ± .47	7.88 ±2.49
Phalanx 2	♂	11	13.9-16.1	15.18 ± .24	0.78 ± .17	5.13 ±1.15
	♀	5	13.7-16.6	14.50 ± .54	1.21 ± .38	8.34 ±2.64
Femur	♂	11	55.2-60.0	56.72 ± .44	1.47 ± .31	2.59 ± .55
	♀	6	51.1-54.5	52.90 ± .43	1.10 ± .32	2.08 ± .60
Tibia	♂	10	126.8-142.7	135.10 ±1.74	5.50 ±1.23	4.07 ± .91
	♀	5	110.8-125.6	120.06 ±2.51	5.63 ±1.78	4.69 ±1.48
Tarsus	♂	10	89.2-108.4	101.90 ±1.85	5.83 ±1.30	5.72 ±1.28
	♀	4	83.7-94.4	89.43 ±2.24	5.02 ±1.59	5.61 ±1.78
Hallux	♂	11	26.2-29.3	27.41 ± .24	0.78 ± .17	2.86 ± .61
	♀	5	25.0-26.9	25.80 ± .38	0.84 ± .27	3.26 ±1.03

Table 1 (cont.)

Skeletal measurements (mm.)

Syrigma sibilatrix

Measurement	Sex	N	R	M	SD	V
Skull	♂	1	114.6	114.60		
Basal Skull	♂	1	111.9	111.90		
Cranium	♂	1	47.5	47.50		
Postorbital	♂	1	28.0	28.00		
Preorbital	♂	1	12.9	12.90		
Pterygoid	♂	1	9.9	9.90		
Quadrate lg	♂	1	13.7	13.70		
Quadrate wd	♂	1	13.0	13.00		
Humerus	♂	1	107.3	107.30		
Ulna	♂	1	128.0	128.00		
Radius	♂	1	122.5	122.50		
Carpometacarpus	♂	1	61.9	61.90		
Phalanx 1	♂	1	22.4	22.40		
Phalanx 2	♂	1	19.0	19.00		
Femur	♂	1	58.0	58.00		
Tibia	♂	1	125.0	125.00		
Tarsus	♂	1	91.3	91.30		
Hallux	♂	1	29.0	29.00		

Table 1 (cont.)

Skeletal measurements (mm.)

Nycticorax nycticorax nycticorax

Measurement	Sex	N	R	M	SD	V
Skull	♂	4	119.0-126.0	124.00 ±1.69	3.37 ±1.19	2.72 ± .96
Basal Skull	♂	4	118.2-123.5	121.80 ±1.22	2.44 ± .86	2.00 ± .71
Cranium	♂	4	50.7-52.9	51.85 ± .57	1.13 ± .40	2.18 ± .77
Postorbital	♂	5	28.7-35.3	33.10 ±1.16	2.60 ± .82	7.85 ±2.48
Preorbital	♂	5	15.2-16.4	15.82 ± .22	0.50 ± .16	3.16 ±1.00
Pterygoid	♂	5	11.9-13.1	12.42 ± .23	0.45 ± .14	3.62 ±1.15
Quadrate lg	♂	5	19.2-20.4	19.86 ± .23	0.45 ± .14	2.27 ± .72
Quadrate wd	♂	5	15.5-16.3	16.02 ± .15	0.33 ± .10	2.06 ± .65
Humerus	♂	4	100.5-109.5	106.28 ±2.02	4.04 ±1.43	3.80 ±1.34
Ulna	♂	4	113.0-124.0	119.63 ±2.41	4.81 ±1.70	4.02 ±1.42
Radius	♂	4	107.6-119.0	114.40 ±2.56	5.12 ±1.81	4.48 ±1.58
Carpometacarpus	♂	4	55.9-60.8	57.60 ±1.11	2.22 ± .78	3.85 ±1.37
Phalanx 1	♂	4	16.0-20.5	18.63 ± .96	1.92 ± .68	10.31 ±3.64
Phalanx 2	♂	4	17.0-19.8	18.48 ± .57	1.13 ± .40	6.11 ±2.16
Femur	♂	4	67.0-70.7	68.88 ± .94	1.88 ± .66	2.73 ± .96
Tibia	♂	4	110.0-122.5	116.73 ±2.55	5.10 ±1.80	4.37 ±1.54
Tarsus	♂	4	73.2-76.8	74.88 ± .67	1.33 ± .47	1.78 ± .63
Hallux	♂	4	25.2-27.2	26.23 ± .36	0.72 ± .25	2.74 ± .97

Table 1 (cont.)

Skeletal measurements (mm.)

Nycticorax nycticorax hoactli

Measurement	Sex	N	R	M	SD	V
Skull	♂	24	128.0-143.5	136.42 ± .70	3.44 ± .50	2.52 ± .31
	♀	17	122.3-139.0	130.53 ± .35	4.60 ± .25	3.53 ± .61
Basal Skull	♂	24	126.5-143.0	135.42 ± .78	3.80 ± .55	2.80 ± .41
	♀	16	121.3-134.8	128.88 ± .35	4.47 ± .25	3.47 ± .61
Cranium	♂	24	54.9-59.5	57.42 ± .29	1.44 ± .21	2.51 ± .36
	♀	16	53.3-57.8	55.88 ± .35	1.41 ± .25	2.52 ± .45
Postorbital	♂	23	34.6-40.0	37.74 ± .22	1.07 ± .16	2.84 ± .42
	♀	14	35.3-37.8	36.43 ± .19	0.70 ± .13	1.93 ± .36
Preorbital	♂	24	16.4-18.7	17.83 ± .13	0.64 ± .09	3.59 ± .52
	♀	16	16.1-19.0	17.89 ± .17	0.68 ± .12	3.73 ± .66
Pterygoid	♂	23	12.9-15.2	14.42 ± .11	0.54 ± .08	3.74 ± .55
	♀	16	12.9-14.3	13.65 ± .09	0.37 ± .06	2.69 ± .48
Quadrate lg	♂	24	20.6-23.2	22.32 ± .13	0.64 ± .09	2.87 ± .41
	♀	17	19.6-22.0	21.16 ± .14	0.57 ± .10	2.70 ± .46
Quadrate wd	♂	24	16.6-19.1	18.03 ± .11	0.53 ± .08	2.94 ± .42
	♀	16	16.4-18.2	17.25 ± .16	0.64 ± .11	3.69 ± .69
Humerus	♂	23	114.3-128.8	119.67 ± .68	3.28 ± .48	2.74 ± .40
	♀	15	106.0-116.2	112.60 ±1.02	3.95 ± .72	3.50 ± .64
Ulna	♂	22	124.3-137.5	130.50 ± .72	3.38 ± .51	2.59 ± .39
	♀	15	114.4-130.8	124.90 ±1.20	4.63 ± .85	3.71 ± .68
Radius	♂	25	117.4-131.6	124.98 ± .69	3.47 ± .49	2.78 ± .39
	♀	16	109.5-124.6	119.04 ±1.21	4.83 ± .85	4.04 ± .71
Carpometacarpus	♂	23	61.6-70.1	65.36 ± .45	2.17 ± .32	3.32 ± .49
	♀	15	59.2-65.3	62.85 ± .28	2.22 ± .41	3.53 ± .65
Phalanx 1	♂	22	21.1-24.8	23.08 ± .22	1.03 ± .15	4.45 ± .67
	♀	16	21.0-23.5	22.53 ± .18	0.73 ± .13	3.23 ± .57
Phalanx 2	♂	22	19.1-21.5	20.32 ± .15	0.71 ± .11	3.50 ± .53
	♀	15	18.6-21.1	19.65 ± .19	0.75 ± .14	3.81 ± .70
Femur	♂	20	73.6-80.4	77.11 ± .48	2.13 ± .34	2.75 ± .44
	♀	15	71.2-78.0	73.85 ± .47	1.84 ± .34	2.49 ± .46
Tibia	♂	18	119.6-136.4	128.50 ± .95	4.03 ± .67	3.14 ± .52
	♀	14	115.8-133.0	124.70 ±1.16	4.36 ± .82	3.49 ± .66
Tarsus	♂	24	77.0-89.7	83.75 ± .70	3.46 ± .50	4.13 ± .60
	♀	15	77.6-86.2	81.07 ± .68	2.62 ± .48	3.23 ± .59
Hallux	♂	23	26.8-31.8	29.60 ± .28	1.32 ± .20	4.46 ± .66
	♀	16	26.8-31.6	28.90 ± .31	1.23 ± .22	4.27 ± .75

Table 1 (cont.)

Skeletal measurements (mm.)

Nycticorax caledonicus

Measurement	Sex	N	R	M	SD	V
Skull	?	1	127.5	127.50		
Basal Skull	?	1	126.5	126.50		
Cranium	?	1	54.2	54.20		
Postorbital	?	1	35.7	35.70		
Preorbital	?	1	16.0	16.00		
Pterygoid	?	1	12.5	12.50		
Quadrate lg	?	1	19.3	19.30		
Quadrate wd	?	1	15.3	15.30		
Humerus	?	1	108.3	108.30		
Ulna	?	1	119.5	119.50		
Radius	?	1	114.1	114.10		
Carpometacarpus	?	1	59.6	59.60		
Phalanx 1	?	1	20.9	20.90		
Phalanx 2	?	1	18.2	18.20		
Femur	?	1	71.0	71.00		
Tibia	?	1	123.0	123.00		
Tarsus	?	1	81.0	81.00		
Hallux	?	1	27.7	27.70		

Table 1 (cont.)

Skeletal measurements (mm.)

Nyctanassa violacea violacea

Measurement	Sex	N	R	M	SD	V
Skull	♂	8	118.5-124.5	122.25 ± .74	2.11 ± .53	1.72 ± .43
	♀	11	111.4-122.5	118.32 ± .98	3.24 ± .69	2.74 ± .58
Basal Skull	♂	8	116.0-123.0	120.50 ± .82	2.60 ± .65	2.16 ± .54
	♀	11	110.0-121.8	116.95 ± .97	3.20 ± .68	2.74 ± .58
Cranium	♂	8	52.1-54.9	53.25 ± .34	0.97 ± .24	1.82 ± .46
	♀	11	49.9-53.7	52.09 ± .35	1.16 ± .25	2.23 ± .48
Postorbital	♂	8	33.4-35.9	34.50 ± .35	1.00 ± .25	2.90 ± .72
	♀	11	32.4-35.2	33.84 ± .29	0.95 ± .20	2.80 ± .60
Preorbital	♂	8	16.1-23.3	20.50 ± .64	1.80 ± .45	8.80 ±2.20
	♀	11	14.7-16.0	15.24 ± .14	0.48 ± .10	3.13 ± .67
Pterygoid	♂	8	11.5-12.3	11.88 ± .08	0.23 ± .06	1.96 ± .49
	♀	11	10.6-12.3	11.73 ± .15	0.51 ± .11	4.37 ± .93
Quadrate lg	♂	7	18.4-20.1	19.30 ± .20	0.52 ± .14	2.71 ± .72
	♀	11	17.9-20.1	18.64 ± .17	0.57 ± .12	3.05 ± .65
Quadrate wd	♂	8	15.0-16.8	15.68 ± .18	0.52 ± .13	3.31 ± .83
	♀	11	14.8-16.6	15.84 ± .16	0.51 ± .11	3.25 ± .69
Humerus	♂	8	106.0-114.7	110.00 ±1.08	3.06 ± .77	2.78 ± .70
	♀	11	103.5-111.0	107.18 ± .75	2.48 ± .53	2.31 ± .49
Ulna	♂	7	125.6-130.4	127.61 ± .51	1.36 ± .36	1.06 ± .28
	♀	10	120.0-129.8	124.10 ±1.13	3.56 ± .80	2.87 ± .64
Radius	♂	8	119.5-123.5	121.63 ± .51	1.45 ± .36	1.19 ± .29
	♀	11	114.5-124.3	118.68 ±1.03	3.41 ± .73	2.87 ± .61
Carpometacarpus	♂	7	59.0-63.5	61.82 ± .50	1.32 ± .35	2.14 ± .57
	♀	11	57.2-62.9	59.77 ± .53	1.76 ± .38	2.95 ± .63
Phalanx 1	♂	8	20.3-22.6	21.50 ± .28	0.79 ± .20	3.69 ± .92
	♀	11	20.3-23.7	21.48 ± .89	0.91 ± .19	4.24 ± .90
Phalanx 2	♂	8	16.4-20.4	18.40 ± .43	1.23 ± .31	6.66 ±1.66
	♀	11	17.1-19.3	18.31 ± .26	0.85 ± .18	4.66 ± .99
Femur	♂	8	63.3-69.8	66.00 ± .59	1.68 ± .42	2.54 ± .64
	♀	11	62.3-68.3	64.70 ± .66	2.19 ± .47	3.39 ± .72
Tibia	♂	8	133.6-148.0	140.13 ±1.64	4.64 ±1.16	3.31 ± .83
	♀	11	126.8-143.5	134.27 ±1.34	4.45 ± .95	3.32 ± .71
Tarsus	♂	8	95.8-107.4	103.25 ±1.27	3.60 ± .90	3.48 ± .87
	♀	11	92.9-104.3	98.77 ±1.12	3.72 ± .79	3.77 ± .80
Hallux	♂	8	22.9-29.0	24.60 ± .47	1.32 ± .33	5.37 ±1.34
	♀	11	22.1-25.2	23.99 ± .31	1.04 ± .22	4.33 ± .92

Table 1 (cont.)

Skeletal measurements (mm.)

Nyctanassa violacea bancrofti

Measurement	Sex	N	R	M	SD	V
Skull	♀	1	122.8	122.80		
Basal Skull	♀	1	120.4	120.40		
Cranium	♀	2	53.4-53.8	53.60		
Postorbital	♀	2	33.3-33.4	33.35		
Preorbital	♀	2	15.4-17.0	16.20		
Pterygoid	♀	2	11.0-11.9	11.45		
Quadrate lg	♀	2	19.0-19.6	19.30		
Quadrate wd	♀	2	16.1-16.5	16.30		
Humerus	♀	2	104.5-110.7	107.60		
Ulna	♀	2	121.3-133.0	127.15		
Radius	♀	2	116.5-127.5	122.00		
Carpometacarpus	♀	2	57.4-63.8	60.60		
Phalanx 1	♀	2	17.2-18.2	17.70		
Phalanx 2	♀	2	22.3-23.5	22.90		
Femur	♀	2	65.5-68.4	66.95		
Tibia	♀	2	137.7-142.0	139.85		
Tarsus	♀	2	101.9-105.8	103.85		
Hallux	♀	2	24.1-24.8	24.45		

Table 1 (cont.)

Skeletal measurements (mm.)

Gorsachius melanolophus

Measurement	Sex	N	R	M	SD	V
Skull	?	1	96.9	96.90		
Basal Skull	?	1	94.6	94.60		
Cranium	?	1	47.6	47.60		
Postorbital	?	1	29.9	29.90		
Preorbital	?	1	12.9	12.90		
Pterygoid	?	1	11.0	11.00		
Quadrate lg	?	1	15.7	15.70		
Quadrate wd	?	1	14.5	14.50		
Humerus	?	1	97.5	97.50		
Ulna	?	1	113.7	113.70		
Radius	?	1	109.4	109.40		
Carpometacarpus	?	1	54.3	54.30		
Phalanx 1	?	1	18.9	18.90		
Phalanx 2	?	1	15.1	15.10		
Femur	?	1	59.3	59.30		
Tibia	?	1	104.7	104.70		
Tarsus	?	1	70.0	70.00		
Hallux	?	1	21.9	21.90		

Table 1 (cont.)

Skeletal measurements (mm.)

Tigriornis leucolopha

Measurement	Sex	N	R	M	SD	V
Skull	♂	2	144.5-147.0	145.75		
Basal Skull	♂	2	143.0-145.0	144.00		
Cranium	♂	2	52.8-55.6	54.20		
Postorbital	♂	2	27.6-28.8	28.20		
Preorbital	♂	2	15.1-15.6	15.35		
Pterygoid	♂	2	11.6-12.3	11.95		
Quadrate lg	♂	2	15.2-15.2	15.20		
Quadrate wd	♂	2	12.4-12.8	12.60		
Humerus	♂	2	91.9-92.6	92.25		
Ulna	♂	2	104.6-109.1	106.85		
Radius	♂	2	99.0-102.6	100.80		
Carpometacarpus	♂	2	46.5-47.2	46.85		
Phalanx 1	♂	2	16.7-17.0	16.85		
Phalanx 2	♂	2	12.3-12.6	12.45		
Femur	♂	2	74.3-75.3	74.80		
Tibia	♂	2	115.1-120.0	117.55		
Tarsus	♂	2	77.2-78.1	77.65		
Hallux	♂	2	26.8-27.2	27.00		

Table 1 (cont.)

Skeletal measurements (mm.)

Tigrisoma lineatum

Measurement	Sex	N	R	M	SD	V
Skull	♂	1	156.0	156.00		
	♀	3	146.5-151.0	149.00		
Basal Skull	♂	1	155.0	155.00		
	♀	3	145.0-150.0	148.00		
Cranium	♂	2	59.0-59.4	59.20		
	♀	3	58.0-59.6	58.80		
Postorbital	♂	2	32.7-39.4	36.05		
	♀	3	31.2-33.2	32.50		
Preorbital	♂	2	16.4-17.0	16.70		
	♀	3	14.9-16.6	15.70		
Pterygoid	♂	2	12.5-12.6	12.55		
	♀	2	11.5-12.8	12.15		
Quadrate lg	♂	2	17.7-18.8	18.25		
	♀	3	17.6-18.0	17.87		
Quadrate wd	♂	2	15.3-15.4	15.35		
	♀	3	14.9-16.7	15.70		
Humerus	♂	2	105.1-108.5	106.80		
	♀	3	99.7-112.3	107.07		
Ulna	♂	1	123.5	123.50		
	♀	3	118.4-133.0	127.63		
Radius	♂	1	116.8	116.80		
	♀	3	111.1-126.5	120.87		
Carpometacarpus	♂	2	56.7-58.4	57.55		
	♀	3	52.9-61.1	57.80		
Phalanx 1	♂	2	18.7-20.2	19.45		
	♀	2	19.9-21.7	20.80		
Phalanx 2	♂	2	14.8-17.1	15.95		
	♀	2	16.4-16.8	16.60		
Femur	♂	2	79.4-82.3	80.85		
	♀	3	73.9-84.3	79.97		
Tibia	♂	2	132.5-134.5	133.50		
	♀	2	141.5-143.5	142.50		
Tarsus	♂	2	94.3-96.3	95.30		
	♀	2	102.6-103.7	103.15		
Hallux	♂	2	28.7-32.3	30.50		
	♀	2	28.3-31.9	30.10		

Table 1 (cont.)

Skeletal measurements (mm.)

Tigrisoma mexicana

Measurement	Sex	N	R	M	SD	V
Skull	♂	4	171.5-185.5	179.63 ±3.02	6.04 ±2.13	3.36 ±1.19
	♀	2	161.0-184.5	172.95		
Basal Skull	♂	4	170.5-183.5	178.38 ±2.87	5.37 ±2.02	3.21 ±1.13
	♀	2	160.0-183.5	171.75		
Cranium	♂	4	63.0-68.0	65.50 ±1.26	2.52 ± .89	3.85 ±1.36
	♀	2	63.5-65.3	64.40		
Postorbital	♂	4	33.5-35.9	34.65 ± .50	0.99 ± .35	2.86 ±1.01
	♀	2	33.2-34.1	33.65		
Preorbital	♂	4	14.9-17.1	16.45 ± .52	1.04 ± .37	6.32 ±2.23
	♀	2	16.0-16.5	16.25		
Pterygoid	♂	4	13.1-14.3	13.83 ± .21	0.41 ± .14	2.96 ±1.05
	♀	2	12.9-13.7	13.30		
Quadrate lg	♂	4	18.6-19.9	19.08 ± .24	0.47 ± .17	2.46 ± .87
	♀	2	17.7-18.5	18.10		
Quadrate wd	♂	4	16.0-16.8	16.48 ± .07	0.14 ± .05	0.85 ± .30
	♀	2	15.6-17.4	16.50		
Humerus	♂	4	126.0-147.0	133.00 ±4.81	9.62 ±3.40	7.23 ±2.55
	♀	3	120.0-133.5	125.83		
Ulna	♂	4	147.0-162.0	155.00 ±3.18	6.36 ±2.25	4.10 ±1.45
	♀	2	146.5-160.0	153.25		
Radius	♂	4	139.5-154.0	147.63 ±3.13	6.26 ±2.21	4.24 ±1.50
	♀	3	132.5-153.5	141.33		
Carpometacarpus	♂	4	67.6-74.6	70.50 ±1.66	3.32 ±1.17	4.71 ±1.66
	♀	2	65.7-71.0	68.35		
Phalanx 1	♂	4	21.6-25.3	23.95 ± .87	1.73 ± .61	7.22 ±2.55
	♀	2	23.8-26.2	25.00		
Phalanx 2	♂	4	19.0-22.0	20.83 ± .64	1.28 ± .45	6.14 ±2.17
	♀	2	20.6-22.4	21.50		
Femur	♂	3	90.4-97.7	93.13		
	♀	3	85.1-93.2	88.07		
Tibia	♂	3	159.0-171.0	163.17		
	♀	2	150.5-169.0	159.75		
Tarsus	♂	4	108.1-121.5	114.45 ±3.04	6.08 ±2.15	5.31 ±1.88
	♀	2	108.3-117.9	113.10		
Hallux	♂	4	34.4-39.5	36.88 ±1.22	2.45 ± .87	6.64 ±2.35
	♀	2	36.0-36.9	36.45		

Table 1 (cont.)

Skeletal measurements (mm.)

Ixobrychus sinensis

Measurement	Sex	N	R	M	SD	V
Skull	?	1	80.8	80.80		
Basal Skull						
Cranium	?	1	30.8	30.80		
Postorbital	?	1	14.4	14.40		
Preorbital	?	1	8.3	8.30		
Pterygoid	?	1	6.2	6.20		
Quadrate lg	?	1	9.1	9.10		
Quadrate wd	?	1	7.4	7.40		
Humerus	?	1	50.4	50.40		
Ulna						
Radius	?	1	51.3	51.30		
Carpometacarpus	?	1	26.3	26.30		
Phalanx 1	?	1	9.2	9.20		
Phalanx 2	?	1	8.4	8.40		
Femur	?	1	43.0	43.00		
Tibia	?	1	66.1	66.10		
Tarsus	?	1	44.0	44.00		
Hallux	?	1	17.9	17.90		

Table 1 (cont.)

Skeletal measurements (mm.)

Ixobrychus involucris

Measurement	Sex	N	R	M	SD	V
Skull	♂	1	83.8	83.80		
Basal Skull						
Cranium	♂	1	31.8	31.80		
Postorbital	♂	1	15.8	15.80		
Preorbital	♂	1	8.4	8.40		
Pterygoid	♂	1	7.7	7.70		
Quadrate lg	♂	1	9.1	9.10		
Quadrate wd	♂	1	7.3	7.30		
Humerus	♂	1	49.4	49.40		
Ulna	♂	1	51.6	51.60		
Radius	♂	1	49.5	49.50		
Carpometacarpus	♂	1	25.6	25.60		
Phalanx 1	♂	1	9.3	9.30		
Phalanx 2	♂	1	8.3	8.30		
Femur	♂	1	44.9	44.90		
Tibia	♂	1	68.7	68.70		
Tarsus	♂	1	43.0	43.00		
Hallux	♂	1	17.7	17.70		

Table 1 (cont.)

Skeletal measurements (mm.)

Ixobrychus exilis

Measurement	Sex	N	R	M	SD	V
Skull	♂	5	74.6-76.6	75.56 ± .33	0.73 ± .23	0.96 ± .30
	♀	2	70.9-71.4	71.15		
Basal Skull	♂	3	73.9-75.5	74.67		
	♀	2	70.8-70.9	70.85		
Cranium	♂	5	29.8-31.5	30.60 ± .29	0.64 ± .20	2.09 ± .66
	♀	3	28.2-30.4	28.97		
Postorbital	♂	5	14.3-15.2	14.96 ± .17	0.37 ± .12	2.47 ± .78
	♀	3	14.2-14.8	14.40		
Preorbital	♂	5	7.7-8.5	8.14 ± .13	0.30 ± .09	3.69 ±1.17
	♀	3	7.5-8.3	7.93		
Pterygoid	♂	5	6.1-6.4	6.26 ± .04	0.10 ± .03	1.59 ± .50
	♀	3	6.0-6.5	6.30		
Quadrate lg	♂	5	8.6-9.3	8.96 ± .12	0.26 ± .08	2.90 ± .92
	♀	3	8.0-9.2	8.63		
Quadrate wd	♂	5	6.9-7.5	7.22 ± .10	0.22 ± .07	3.05 ± .97
	♀	3	6.7-7.2	7.00		
Humerus	♂	6	45.3-46.9	46.00 ± .48	1.18 ± .34	2.57 ± .74
	♀	3	41.5-47.6	44.77		
Ulna	♂	6	46.3-47.9	47.22 ± .16	0.40 ± .12	0.85 ± .25
	♀	3	43.2-49.0	46.23		
Radius	♂	5	43.7-45.4	44.72 ± .31	0.69 ± .22	1.54 ± .49
	♀	3	40.6-46.4	43.60		
Carpometacarpus	♂	5	23.3-24.8	24.10 ± .30	0.67 ± .21	2.78 ± .88
	♀	3	21.4-24.7	23.30		
Phalanx 1	♂	5	8.1-8.2	8.17 ± .15	0.33 ± .10	4.04 ±1.28
	♀	3	7.5-8.0	7.80		
Phalanx 2	♂	5	6.4-7.5	7.18 ± .23	0.51 ± .16	7.10 ±2.25
	♀	3	6.9-7.6	7.33		
Femur	♂	6	40.4-42.2	41.03 ± .37	0.91 ± .26	2.22 ± .64
	♀	4	36.5-43.6	40.65 ±1.58	3.15 ±1.11	7.75 ±2.74
Tibia	♂	6	63.1-64.7	63.83 ± .31	0.77 ± .22	1.21 ± .35
	♀	2	58.5-61.3	59.90		
Tarsus	♂	4	39.5-40.8	40.40 ± .31	0.61 ± .22	1.51 ± .53
	♀	3	36.5-41.9	39.40		
Hallux	♂	5	16.1-17.2	16.72 ± .23	0.51 ± .16	3.05 ± .97
	♀	3	15.0-16.9	16.27		

Table 1 (cont.)

Skeletal measurements (mm.)

Ixobrychus cinnamomeus

Measurement	Sex	N	R	M	SD	V
Skull	♂	1	84.6	84.60		
Basal Skull	♂	1	84.6	84.60		
Cranium	♂	1	35.3	35.30		
Postorbital	♂	1	18.9	18.90		
Preorbital	♂	1	11.4	11.40		
Pterygoid	♂	1	7.3	7.30		
Quadrate lg	♂	1	12.0	12.00		
Quadrate wd	♂	1	9.1	9.10		
Humerus	♂	1	58.2	58.20		
Ulna	♂	1	62.8	62.80		
Radius	♂	1	58.1	58.10		
Carpometacarpus	♂	1	33.4	33.40		
Phalanx 1	♂	1	11.0	11.00		
Phalanx 2	♂	1	9.8	9.80		
Femur	♂	1	48.3	48.30		
Tibia	♂	1	75.8	75.80		
Tarsus	♂	1	47.9	47.90		
Hallux	♂	1	19.8	19.80		

Table 1 (cont.)

Skeletal measurements (mm.)

Ixobrychus strumii

Measurement	Sex	N	R	M	SD	V
Skull	♀	1	74.9	74.90		
Basal Skull	♀	1	72.4	72.40		
Cranium	♀	1	35.0	35.00		
Postorbital	♀	1	19.3	19.30		
Preorbital	♀	1	9.6	9.60		
Pterygoid						
Quadrate lg	♀	1	9.9	9.90		
Quadrate wd	♀	1	9.0	9.00		
Humerus	♀	1	62.7	62.70		
Ulna	♀	1	67.7	67.70		
Radius	♀	1	64.4	64.40		
Carpometacarpus	♀	1	35.3	35.30		
Phalanx 1	♀	1	12.1	12.10		
Phalanx 2	♀	1	11.1	11.10		
Femur	♀	1	45.6	45.60		
Tibia	♀	1	70.1	70.10		
Tarsus	♀	1	43.7	43.70		
Hallux	♀	1	19.1	19.10		

Table 1 (cont.)

Skeletal measurements (mm.)

Botaurus stellaris

Measurement	Sex	N	R	M	SD	V
Skull	♂	1	127.0	127.00		
	♀	2	125.5-127.0	126.25		
Basal Skull	♂	1	129.5	129.50		
	♀	2	126.0-127.0	126.50		
Cranium	♂	1	57.3	57.30		
	♀	2	55.3-56.2	55.75		
Postorbital	♂	1	29.0	29.00		
	♀	2	27.1-29.3	28.20		
Preorbital	♂	1	16.8	16.80		
	♀	2	16.5-16.9	16.70		
Pterygoid	♂	1	13.6	13.60		
	♀	2	13.0-13.3	13.15		
Quadrate lg	♂	1	20.0	20.00		
	♀	2	19.5-20.7	20.10		
Quadrate wd	♂	1	15.6	15.60		
	♀	2	14.8-16.0	15.40		
Humerus	♂	1	137.5	137.50		
	♀	2	135.0-137.0	136.00		
Ulna	♂	1	150.0	150.00		
	♀	2	147.5-149.0	148.25		
Radius	♂	1	143.5	143.50		
	♀	2	140.5-142.0	141.25		
Carpometacarpus	♂	1	75.4	75.40		
	♀	2	74.1-74.6	74.35		
Phalanx 1	♂	1	23.3	23.30		
	♀	2	23.1-25.9	24.50		
Phalanx 2	♂	1	20.0	20.00		
	♀	1	21.4	21.40		
Femur	♂	1	101.0	101.00		
	♀	2	89.8-103.3	96.52		
Tibia	♂	1	158.0	158.00		
	♀	2	157.5-158.0	157.75		
Tarsus	♂	1	101.9	101.90		
	♀	2	99.0-99.8	99.40		
Hallux	♂	1	37.4	37.40		
	♀	2	37.4-39.1	38.25		

Table 1 (cont.)

Skeletal measurements (mm.)

Botaurus lentiginosus

Measurement	Sex	N	R	M	SD	V
Skull	♂	9	119.2-135.5	127.50 ±1.16	3.46 ± .82	2.72 ± .64
	♀	9	114.6-125.5	119.50 ±1.16	3.46 ± .82	2.90 ± .68
Basal Skull	♂	8	120.0-134.0	128.50 ±1.65	4.66 ±1.17	3.63 ± .91
	♀	9	114.0-125.5	118.60 ±1.05	3.16 ± .75	2.67 ± .39
Cranium	♂	10	51.5-54.4	53.08 ± .33	1.04 ± .23	1.96 ± .44
	♀	9	46.9-53.2	48.66 ± .77	2.32 ± .55	4.77 ±1.12
Postorbital	♂	10	25.0-26.8	26.24 ± .16	0.51 ± .11	1.95 ± .44
	♀	8	24.4-26.3	25.45 ± .27	0.75 ± .19	2.95 ± .74
Preorbital	♂	9	14.0-17.0	15.35 ± .29	0.87 ± .21	5.69 ±1.34
	♀	8	13.8-15.5	15.10 ± .19	0.46 ± .13	3.06 ±1.25
Pterygoid	♂	10	10.5-11.9	11.27 ± .15	0.49 ± .11	4.32 ± .97
	♀	9	9.4-11.6	10.16 ± .27	0.82 ± .19	8.03 ±1.89
Quadrate lg	♂	10	16.8-18.2	17.38 ± .15	0.48 ± .11	2.73 ± .61
	♀	9	15.1-17.4	16.26 ± .23	0.70 ± .17	4.31 ±1.02
Quadrate wd	♂	10	13.0-14.5	13.64 ± .14	0.43 ± .10	3.16 ± .71
	♀	9	12.4-14.1	13.08 ± .19	0.57 ± .14	4.37 ±1.03
Humerus	♂	10	107.5-118.0	112.80 ± .81	2.56 ± .57	2.27 ± .51
	♀	8	93.2-115.5	104.50 ±1.03	2.91 ± .73	2.78 ± .70
Ulna	♂	9	115.5-129.5	123.49 ±1.10	3.30 ± .78	2.67 ± .63
	♀	9	103.0-127.5	114.00 ±2.31	6.93 ±1.63	6.08 ±1.43
Radius	♂	9	109.5-122.0	116.50 ±1.22	2.65 ± .86	3.13 ± .74
	♀	9	97.5-122.5	107.68 ±2.28	6.83 ±1.61	6.34 ±1.49
Carpometacarpus	♂	10	60.6-67.5	64.00 ± .68	2.15 ± .48	3.36 ± .75
	♀	9	54.8-66.6	60.17 ±1.10	3.30 ± .79	5.48 ±1.29
Phalanx 1	♂	10	19.5-21.9	21.00 ± .24	0.76 ± .17	3.61 ± .81
	♀	9	17.6-22.5	19.75 ± .47	1.40 ± .33	7.09 ±1.67
Phalanx 2	♂	8	16.0-18.2	17.45 ± .29	0.81 ± .20	4.63 ±1.16
	♀	7	14.6-17.0	17.85 ± .33	0.87 ± .23	4.89 ±1.31
Femur	♂	9	78.5-85.0	82.57 ± .83	2.50 ± .69	3.02 ± .72
	♀	8	66.3-85.9	75.87 ±2.06	5.83 ±1.46	7.68 ±1.92
Tibia	♂	9	127.5-139.0	134.17 ±1.10	3.30 ± .78	2.46 ± .58
	♀	9	109.2-134.0	121.68 ±2.27	6.80 ±1.60	5.59 ±1.32
Tarsus	♂	9	80.7-95.7	91.00 ±1.83	5.48 ±1.29	6.02 ±1.42
	♀	9	75.1-91.8	83.32 ±1.73	5.18 ±1.22	6.22 ±1.47
Hallux	♂	10	34.6-37.3	35.75 ± .26	0.83 ± .19	2.32 ± .52
	♀	9	30.9-37.0	33.69 ± .58	1.75 ± .41	5.19 ±1.22

Table 1 (cont.)

Skeletal measurements (mm.)

Cochlearius cochlearius

Measurement	Sex	N	R	M	SD	V
Skull	?	2	119.9-124.5	122.20		
Basal Skull	?	2	116.5-119.0	117.75		
Cranium	?	2	53.6-54.0	53.80		
Postorbital	?	2	37.5-37.7	37.60		
Preorbital	?	2	19.0-22.0	20.50		
Pterygoid	?	2	12.4-13.1	12.75		
Quadrate lg	?	2	19.0-19.4	19.20		
Quadrate wd	?	2	18.2-18.2	18.20		
Humerus	?	2	92.9-95.0	93.95		
Ulna	?	2	105.3-111.2	108.25		
Radius	?	2	99.9-104.9	102.40		
Carpometacarpus	?	2	48.0-49.0	48.50		
Phalanx 1	?	2	18.4-19.0	18.70		
Phalanx 2	?	2	15.5-16.3	15.90		
Femur	?	2	65.7-66.2	65.95		
Tibia	?	2	111.4-123.0	117.20		
Tarsus	?	2	72.5-82.6	77.55		
Hallux	?	1	25.6	25.60		

Table 2

Ratios (per cent)

Ardea sumatrana

Ratio	N	R	M	SD	V
Pre/sk	1	9.2	9.20		
Pre/Post	1	57.4	57.40		
Pre/Cr	1	28.8	28.80		
Post/Cr	1	50.1	50.10		
Pt/Ql	1	61.7	61.70		
Qw/Ql	1	81.3	81.30		
Fe/Hu	1	62.5	62.50		
Fe/Ul	1	50.2	50.20		
Fe/Cmc	1	124.9	124.90		
Ti/Hu	1	130.7	130.70		
Ti/Ul	1	104.9	104.90		
Ti/Cmc	1	261.2	261.20		
Ta/Hu	1	91.1	91.10		
Ta/Ul	1	73.1	73.10		
Ta/Cmc	1	181.9	181.90		
Ha/Hu	1	27.4	27.40		
Ha/Ul	1	22.0	22.00		
Ha/Cmc	1	54.8	54.80		
Hu/Ul	1	80.3	80.30		
Ra/Ul	1	91.7	91.70		
Cmc/Ul	1	40.2	40.20		
P-1/Ul	1	14.6	14.60		
P-2/Ul	1	12.1	12.10		
Fe/Ti	1	47.8	47.80		
Ta/Ti	1	69.7	69.70		
Ha/Ti	1	21.0	21.00		

Table 2 (cont.)

Ratios (per cent)

Ardea goliath

Ratio	N	R	M	SD	V
Pre/Sk	4	10.4-11.1	10.65 ± .16	0.32 ± .11	3.00 ± 1.06
Pre/Post	2	54.6-57.0	55.80		
Pre/Cr	4	29.3-31.7	30.65 ± .53	1.05 ± .37	3.43 ± 1.21
Post/Cr	2	53.7-55.6	54.65		
Pt/Ql	3	58.5-63.1	60.23		
Qw/Ql	4	78.1-83.0	80.25 ±1.12	2.24 ± .79	2.79 ± .99
Fe/Hu	4	56.7-61.4	58.70 ± .99	1.97 ± .70	3.36 ± 1.19
Fe/Ul	2	51.5-54.3	52.90		
Fe/Cmc	3	114.8-120.7	117.30		
Ti/Hu	3	124.2-127.6	125.57		
Ti/Ul	2	110.1-111.5	110.80		
Ti/Cmc	3	252.7-257.7	254.66		
Ta/Hu	4	87.5-92.0	88.83 ± .99	1.97 ± .70	2.22 ± .78
Ta/Ul	2	77.4-77.9	77.65		
Ta/Cmc	3	174.5-186.1	181.00		
Ha/Hu	3	27.3-28.3	27.63		
Ha/Ul	2	24.2-25.1	24.65		
Ha/Cmc	2	54.3-56.6	55.45		
Hu/Ul	2	88.5-88.7	88.60		
Ra/Ul	2	95.0-96.1	95.55		
Cmc/Ul	2	42.7-44	43.35		
P-1/Ul	2	15.7-17.2	16.60		
P-2/Ul	1	13.1	13.10		
Fe/Ti	3	45.5-46.8	46.73		
Ta/Ti	3	68.8-73.7	71.10		
Ha/Ti	2	21.4-21.9	21.65		

Table 2 (cont.)

Ratios (per cent)

Ardea melanocephala

Ratio	N	R	M	SD	V
Pre/Sk	2	11.2-11.4	11.30		
Pre/Post	2	50.7-51.3	51.00		
Pre/Cr	2	29.2-30.3	29.75		
Post/Cr	2	56.9-59.8	58.35		
Pt/Ql	2	61.9-64.8	63.35		
Qw/Ql	2	79.7-79.8	79.75		
Fe/Hu	2	55.5-55.5	55.50		
Fe/Ul	2	47.2-47.6	47.40		
Fe/Cmc	2	105.5-108.7	107.10		
Ti/Hu	2	125.1-127.2	126.15		
Ti/Ul	2	106.5-109.1	107.80		
Ti/Cmc	2	245.3-249.1	247.20		
Ta/Hu	2	91.1-93.6	92.35		
Ta/Ul	2	77.6-80.2	78.90		
Ta/Cmc	2	178.7-183.2	180.95		
Ha/Hu	2	21.7-23.1	22.40		
Ha/Ul	2	18.6-19.6	19.10		
Ha/Cmc	2	42.4-45.1	43.75		
Hu/Ul	2	85.1-85.7	85.40		
Ra/Ul	2	96.2-96.5	96.35		
Cmc/Ul	2	43.4-43.8	43.60		
P-1/Ul	2	14.2-15.4	14.80		
P-2/Ul	2	13.5-13.7	13.60		
Fe/Ti	2	43.7-44.4	44.05		
Ta/Ti	2	72.8-73.6	73.20		
Ha/Ti	2	17.0-18.4	17.70		

Table 2 (cont.)

Ratios (per cent)

Ardea cinerea

Ratio	N	R	M	SD	V
Pre/Sk	9	10.1-11.9	10.76 ± 1.33	0.40 ± .94	3.72 ± .88
Pre/Post	9	53.6-60.8	56.37 ± .77	2.31 ± .54	4.10 ± .97
Pre/Cr	9	27.7-32.6	29.72 ± .63	1.89 ± .45	6.36 ±1.50
Post/Cr	9	50.0-55.9	52.71 ± .57	1.70 ± .40	3.23 ± .76
Pt/Ql	9	58.5-66.7	63.63 ± 1.02	3.05 ± .72	4.79 ±1.13
Qw/Ql	9	74.8-85.0	78.64 ± 1.07	3.22 ± .76	4.09 ± .96
Fe/Hu	12	49.8-53.5	51.80 ± .34	1.14 ± .23	2.20 ± .45
Fe/Ul	9	42.5-45.8	44.20 ± .34	1.02 ± .24	2.31 ± .54
Fe/Cmc	10	94.7-100.0	97.33 ± .67	2.13 ± .48	2.19 ± .49
Ti/Hu	9	110.7-125.1	116.62 ± 1.51	4.54 ±1.07	3.89 ± .92
Ti/Ul	9	94.7-102.4	99.02 ± .98	2.94 ± .69	2.79 ± .70
Ti/Cmc	10	206.9-230.1	219.63 ± 2.42	7.64 ±1.71	3.48 ± .78
Ta/Hu	9	80.4-92.4	87.40 ± 1.21	3.63 ± .86	4.15 ± .98
Ta/Ul	9	68.7-76.7	74.29 ± .81	2.43 ± .57	3.27 ± .77
Ta/Cmc	10	150.1-171.0	164.51 ± 2.03	6.42 ±1.44	3.90 ± .87
Ha/Hu	9	19.7-22.5	20.44 ± .32	0.95 ± .22	4.65 ±1.10
Ha/Ul	9	16.8-18.1	17.26 ± .12	0.36 ± .08	2.09 ± .49
Ha/Cmc	10	36.9-41.3	38.39 ± .27	0.85 ± .19	2.21 ± .49
Hu/Ul	8	83.8-86.8	85.33 ± .17	0.47 ± .12	0.55 ± .14
Ra/Ul	9	95.8-97.2	96.36 ± .31	0.94 ± .22	0.98 ± .23
Cmc/Ul	9	44.0-46.1	45.34 ± .29	0.87 ± .21	1.92 ± .45
P-1/Ul	9	15.1-16.4	15.86 ± .20	0.61 ± .14	3.85 ± .91
P-2/Ul	9	13.1-14.2	13.48 ± .29	0.88 ± .21	6.53 ±1.54
Fe/Ti	10	43.0-48.3	44.36 ± .53	1.69 ± .38	3.81 ± .85
Ta/Ti	10	72.6-80.8	74.93 ± .80	2.52 ± .56	3.36 ± .75
Ha/Ti	10	16.8-18.0	17.47 ± .12	0.37 ± .08	2.12 ± .47

Table 2 (cont.)

Ratios (per cent)

Ardea herodias treganzai

Ratio	N	R	M	SD	V
Pre/Sk	7	9.2-9.9	9.61 ± .43	1.14 ± .30	11.86 ± 3.17
Pre/Post	8	53.1-57.8	55.68 ±2.53	7.15 ±1.79	12.84 ± 3.21
Pre/Cr	7	27.0-29.0	28.46 ± .14	0.37 ± .10	1.30 ± .35
Post/Cr	7	49.6-51.9	50.77 ± .36	0.95 ± .25	1.87 ± .50
Pt/Ql	8	58.9-67.0	62.66 ±1.13	3.19 ± .80	5.09 ± 1.27
Qw/Ql	8	79.0-84.5	81.96 ± .71	2.01 ± .50	2.45 ± .61
Fe/Hu	5	52.4-53.9	53.52 ± .28	0.63 ± .20	1.18 ± .37
Fe/Ul	7	43.9-48.5	45.73 ± .72	1.90 ± .51	4.15 ± 1.11
Fe/Cmc	7	98.8-103.7	101.29 ± .61	1.62 ± .43	1.60 ± .43
Ti/Hu	5	124.0-132.9	128.48 ±1.89	4.23 ±1.34	3.29 ± 1.04
Ti/Ul	7	104.0-112.3	109.00 ±1.09	2.90 ± .78	2.66 ± .71
Ti/Cmc	7	229.7-249.2	241.31 ±2.75	7.29 ±1.95	3.02 ± .81
Ta/Hu	5	92.8-96.2	95.04 ± .67	1.49 ± .47	1.57 ± .50
Ta/Ul	7	79.7-81.9	80.63 ± .30	0.80 ± .25	0.99 ± .32
Ta/Cmc	7	170.6-181.6	178.49 ±1.36	3.61 ±1.15	2.02 ± .64
Ha/Hu	5	21.8-24.0	23.16 ± .39	0.88 ± .28	3.80 ± 1.20
Ha/Ul	8	19.2-21.3	19.84 ± .24	0.67 ± .17	3.38 ± .85
Ha/Cmc	8	42.7-45.2	43.93 ± .25	0.70 ± .18	1.59 ± .40
Hu/Ul	5	83.3-88.0	85.03 ± .67	1.51 ± .48	1.78 ± ..56
Ra/Ul	7	96.0-97.2	96.31 ± .57	1.51 ± .48	1.57 ± .50
Cmc/Ul	8	44.4-47.2	45.18 ± .39	1.07 ± .27	2.37 ± .59
P-1/Ul	7	16.1-18.4	16.88 ± .23	0.61 ± .19	3.61 ± 1.15
P-2/Ul	7	13.2-14.5	13.79 ± .17	0.44 ± .14	3.19 ± 1.02
Fe/Ti	7	40.5-43.8	41.94 ± .38	1.00 ± .32	2.38 ± .76
Ta/Ti	7	72.3-77.6	74.01 ± .65	1.72 ± .55	2.32 ± .74
Ha/Ti	7	17.3-19.3	18.23 ± .34	0.90 ± .29	4.94 ± 1.57

Table 2 (cont.)

Ratios (per cent)

Ardea herodias herodias

Ratio	N	R	M	SD	V
Pre/Sk	37	8.8-10.2	9.64 ± .06	0.35 ± .04	3.63 ± .42
Pre/Post	34	51.2-59.4	55.23 ± .36	2.13 ± .26	3.86 ± .47
Pre/Cr	31	27.3-29.3	28.18 ± .38	2.10 ± .27	7.45 ± .95
Post/Cr	30	47.8-54.2	51.04 ± .29	1.59 ± .21	3.12 ± .40
Pt/Ql	32	62.3-72.8	66.10 ± .38	2.14 ± .27	3.24 ± .41
Qw/Ql	33	74.5-84.4	78.88 ± .48	2.77 ± .34	3.51 ± .43
Fe/Hu	31	50.5-55.6	53.18 ± .27	1.53 ± .19	2.88 ± .37
Fe/Ul	31	43.2-47.1	45.14 ± .25	1.38 ± .18	3.06 ± .39
Fe/Cmc	31	96.0-106.3	101.05 ± .49	2.73 ± .35	2.70 ± .34
Ti/Hu	31	112.6-133.6	126.79 ± .81	4.50 ± .57	3.55 ± .45
Ti/Ul	32	100.5-115.4	107.86 ± .60	3.38 ± .42	3.13 ± .39
Ti/Cmc	32	225.3-255.9	241.40 ±1.41	7.99 ±1.00	3.31 ± .41
Ta/Hu	32	84.0-98.7	93.71 ± .57	3.22 ± .40	3.44 ± .43
Ta/Ul	33	74.5-84.7	79.65 ± .49	2.82 ± .35	3.54 ± .44
Ta/Cmc	33	164.4-191.3	178.29 ±1.18	6.76 ± .83	3.79 ± .47
Ha/Hu	32	21.5-24.7	22.73 ± .19	1.07 ± .13	4.71 ± .59
Ha/Ul	33	18.0-21.1	19.32 ± .14	0.78 ± .10	4.04 ± .50
Ha/Cmc	33	39.6-47.4	43.22 ± .27	1.53 ± .19	3.54 ± .44
Hu/Ul	39	83.1-86.4	84.68 ± .20	1.26 ± .14	1.49 ± .17
Ra/Ul	40	91.9-97.0	96.29 ± .06	0.37 ± .04	0.38 ± .04
Cmc/Ul	39	42.6-45.9	44.71 ± .14	0.85 ± .10	1.90 ± .22
P-1/Ul	40	14.7-17.3	15.67 ± .09	0.57 ± .06	3.64 ± .41
P-2/Ul	40	12.6-14.3	13.30 ± .05	0.33 ± .04	2.48 ± .28
Fe/Ti	37	39.3-44.8	41.98 ± .19	1.18 ± .14	2.81 ± .33
Ta/Ti	39	71.3-77.6	74.23 ± .19	1.16 ± .13	1.56 ± .18
Ha/Ti	39	16.3-19.3	17.98 ± .11	0.68 ± .08	3.78 ± .43

Table 2 (cont.)

Ratios (per cent)

Ardea occidentalis

Ratio	N	R	M	SD	V
Pre/Sk	2	9.3- 9.7	9.50		
Pre/Post	3	52.7-57.2	54.60		
Pre/Cr	3	27.6-28.9	28.07		
Post/Cr	3	50.5-52.4	51.40		
Ft/Ql	3	66.1-72.9	68.40		
Qw/Ql	3	76.7-80.2	78.33		
Fe/Hu	3	54.4-55.1	54.77		
Fe/Ul	3	46.9-47.8	47.27		
Fe/Cmc	3	102.4-107.0	104.80		
Ti/Hu	3	118.5-123.4	120.70		
Ti/Ul	3	102.1-107.5	104.13		
Ti/Cmc	3	223.4-240.8	230.97		
Ta/Hu	3	86.9-94.7	91.63		
Ta/Ul	3	73.8-82.5	79.06		
Ta/Cmc	3	165.5-184.8	175.33		
Ha/Hu	3	23.8-24.4	24.03		
Ha/Ul	3	20.3-21.2	20.73		
Ha/Cmc	3	45.5-46.4	45.97		
Hu/Ul	3	85.0-87.2	86.30		
Ra/Ul	3	96.0-96.3	96.20		
Cmc/Ul	3	44.6-46.0	45.07		
P-1/Ul	3	15.2-16.3	15.67		
P-2/Ul	3	13.7-14.5	14.00		
Fe/Ti	3	44.5-45.9	45.43		
Ta/Ti	3	72.3-78.7	75.90		
Ha/Ti	3	19.3-20.6	19.93		

Table 2 (cont.)

Ratios (per cent)

Ardea cocoi

Ratio	N	R	M	SD	V
Pre/Sk	4	9.8-12.0	10.63 ± .46	0.92 ± .36	8.65 ± 3.06
Pre/Post	3	56.7-59.3	57.80		
Pre/Cr	4	29.0-34.1	30.83 ±1.18	2.35 ± .83	7.62 ± 2.69
Post/Cr	3	50.5-52.6	51.43		
Pt/Ql	3	58.8-64.5	62.53		
Qw/Ql	3	75.5-81.1	77.47		
Fe/Hu	2	54.2-58.1	56.15		
Fe/Ul	2	49.3-49.9	49.60		
Fe/Cmc	2	111.1-113.6	112.35		
Ti/Hu	2	135.8-136.9	136.35		
Ti/Ul	3	115.7-116.7	116.27		
Ti/Cmc	3	259.8-277.3	268.33		
Ta/Hu	2	101.1-101.8	101.45		
Ta/Ul	3	85.9-87.7	86.77		
Ta/Cmc	3	195.2-207.8	200.27		
Ha/Hu	2	23.9-25.0	24.45		
Ha/Ul	3	20.3-22.0	21.17		
Ha/Cmc	3	48.8-49.1	48.93		
Hu/Ul	2	85.0-85.2	85.10		
Ra/Ul	3	92.1-96.6	94.77		
Cmc/Ul	3	41.7-44.9	43.33		
P-1/Ul	2	15.5-16.0	15.75		
P-2/Ul	3	13.5-14.5	14.13		
Fe/Ti	2	42.2-42.7	42.55		
Ta/Ti	3	73.8-75.1	74.63		
Ha/Ti	3	17.6-18.9	18.27		

Table 2 (cont.)

Ratios (per cent)

Ardea pacifica

Ratio	N	R	M	SD	V
Pre/Sk	1	11.2	11.20		
Pre/Post	2	50.9-53.1	52.00		
Pre/Cr	2	27.5-28.4	27.95		
Post/Cr	2	53.5-54.0	53.75		
Pt/Ql	2	70.5-72.2	71.35		
Qw/Ql	2	84.6-84.8	84.70		
Fe/Hu	2	48.3-49.0	48.65		
Fe/Ul	2	41.2-41.4	41.30		
Fe/Cmc	2	85.0-87.3	86.15		
Ti/Hu	2	110.7-1120	111.35		
Ti/Ul	2	92.9-96.0	94.45		
Ti/Cmc	2	197.0-197.3	197.15		
Ta/Hu	2	85.1-87.3	86.20		
Ta/Ul	2	71.4-74.8	73.10		
Ta/Cmc	2	151.5-153.7	152.55		
Ha/Hu	2	22.7-22.9	22.80		
Ha/Ul	2	19.3-19.4	19.35		
Ha/Cmc	2	39.9-40.8	40.35		
Hu/Ul	2	84.0-85.7	84.85		
Ra/Ul	2	95.7-96.6	96.15		
Cmc/Ul	2	47.2-48.7	47.95		
P-1/Ul	2	17.3-17.6	17.45		
P-2/Ul	2	15.1-15.4	15.25		
Fe/Ti	2	43.1-44.3	43.70		
Ta/Ti	2	76.9-77.9	77.40		
Ha/Ti	2	20.2-20.7	20.45		

Table 2 (cont.)

Ratios (per cent)

Ardea purpurea

Ratio	N	R	M	SD	V
Pre/Sk	1	8.6	8.60		
Pre/Post	6	56.9-62.2	60.05 ± .87	2.12 ± .61	3.53 ± 1.02
Pre/Cr	6	25.9-27.4	26.80 ± .23	0.57 ± .16	2.13 ± .62
Post/Cr	6	43.1-46.6	44.66 ± .55	1.35 ± .39	3.02 ± .87
Pt/Ql	5	62.5-68.2	64.64 ± .99	2.22 ± .70	3.43 ± 1.09
Qw/Ql	5	77.3-82.1	79.48 ± .97	2.17 ± .69	2.73 ± .86
Fe/Hu	6	63.4-67.1	65.25 ± .56	1.38 ± .40	2.11 ± .61
Fe/Ul	5	54.4-58.6	56.74 ± .83	1.86 ± .59	3.28 ± 1.04
Fe/Cmc	6	119.3-128.2	122.51 ±1.59	3.90 ±1.13	3.18 ± .92
Ti/Hu	6	117.1-130.8	123.53 ±2.35	5.76 ±1.66	4.66 ± 1.35
Ti/Ul	5	103.2-107.5	105.42 ± .92	2.05 ± .65	1.94 ± .61
Ti/Cmc	6	217.9-246.1	231.90 ±3.95	9.67 ±2.79	4.17 ± 1.21
Ta/Hu	6	83.6-91.1	88.02 ±1.23	3.01 ± .87	3.43 ± .99
Ta/Ul	5	73.9-80.1	75.72 ±1.65	3.69 ±1.17	4.87 ± 1.57
Ta/Cmc	6	155.6-175.3	165.28 ± .90	2.20 ± .64	1.33 ± .38
Ha/Hu	6	32.2-33.9	33.13 ± .31	0.77 ± .22	2.32 ± .67
Ha/Ul	5	27.0-29.9	28.54 ± .54	1.20 ± .38	4.20 ± 1.33
Ha/Cmc	6	59.7-65.4	62.23 ± .89	2.19 ± .63	3.52 ± 1.02
Hu/Ul	5	83.4-88.4	86.40 ± .98	2.20 ± .70	2.55 ± .81
Ra/Ul	5	95.3-96.5	96.02 ± .21	0.46 ± .15	0.48 ± .15
Cmc/Ul	5	45.2-47.5	46.05 ± .53	1.19 ± .38	2.58 ± .82
P-1/Ul	5	15.5-17.1	16.40 ± .11	0.24 ± .08	1.46 ± .46
P-2/Ul	5	12.1-14.8	13.28 ± .46	1.03 ± .33	7.76 ± 2.46
Fe/Ti	6	48.5-56.8	52.93 ±1.20	2.95 ± .85	5.57 ± 1.61
Ta/Ti	6	68.6-77.6	71.34 ±1.28	3.14 ± .91	4.40 ± 1.27
Ha/Ti	6	25.1-28.9	26.87 ± .57	1.39 ± .40	5.17 ± 1.49

Table 2 (cont.)

Ratios (per cent)

Pilherodius pileatus

Ratio	N	R	M	SD	V
Pre/Sk	4	9.6-10.2	10.13 ± .13	0.26 ± .09	2.57 ± .91
Pre/Post	6	45.9-49.6	48.07 ± .67	1.66 ± .48	3.45 ± .99
Pre/Cr	6	26.2-28.9	27.48 ± .43	1.05 ± .30	3.82 ±1.10
Post/Cr	6	56.1-58.3	57.12 ± .23	0.57 ± .16	1.00 ± .29
Pt/Ql	6	67.4-73.1	70.60 ± .89	2.20 ± .63	3.12 ± .90
Qw/Ql	6	84.7-88.9	87.00 ± .69	1.70 ± .49	1.95 ± .56
Fe/Hu	5	60.7-65.1	63.62 ± .76	1.71 ± .54	2.69 ± .85
Fe/Ul	4	46.8-52.7	50.30 ±1.25	2.49 ± .88	4.95 ±1.75
Fe/Cmc	6	102.5-110.7	107.37 ±1.16	2.86 ± .82	2.66 ± .77
Ti/Hu	5	136.4-139.9	137.74 ± .61	1.36 ± .43	0.99 ± .31
Ti/Ul	4	106.3-110.0	108.53 ± .66	1.32 ± .47	1.22 ± .43
Ti/Cmc	6	226.9-234.1	231.00 ±1.06	2.63 ± .76	1.14 ± .33
Ta/Hu	5	95.4-104.9	100.42 ±1.57	3.51 ±1.11	3.50 ±1.11
Ta/Ul	4	73.6-81.4	78.80 ±1.81	3.61 ±1.28	4.58 ±1.62
Ta/Cmc	6	161.1-174.9	168.73 ±1.87	4.60 ±1.33	2.73 ± .79
Ha/Hu	5	28.5-30.3	29.36 ± .41	0.92 ± .29	3.13 ± .99
Ha/Ul	4	22.0-23.5	22.88 ± .30	0.59 ± .21	2.58 ± .91
Ha/Cmc	6	48.1-50.3	49.25 ± .47	1.16 ± .33	2.36 ± .68
Hu/Ul	3	77.1-79.6	78.60		
Ra/Ul	4	94.9-95.7	95.27 ± .44	0.87 ± .31	0.91 ± .32
Cmc/Ul	4	45.7-47.6	46.68 ± .23	0.45 ± .16	0.96 ± .34
P-1/Ul	4	16.4-17.5	16.88 ± .18	0.35 ± .12	2.07 ± .73
P-2/Ul	4	13.7-14.6	14.28 ± .26	0.51 ± .18	3.57 ±1.26
Fe/Ti	6	44.0-47.9	46.47 ± .50	1.23 ± .35	2.65 ± .76
Ta/Ti	6	69.2-75.0	73.05 ± .85	2.10 ± .61	2.87 ± .83
Ha/Ti	6	20.7-22.2	21.32 ± .20	0.48 ± .14	2.25 ± .65

Table 2 (cont.)

Ratios (per cent)

Butorides virescens virescens

Ratio	N	R	M	SD	V
Pre/Sk	26	10.5-11.9	11.23 ± .15	0.75 ± .10	6.68 ± .93
Pre/Post	25	49.1-59.6	53.24 ± .60	3.01 ± .43	5.65 ± .80
Pre/Cr	24	26.1-31.6	28.38 ± .27	1.30 ± .19	4.58 ± .66
Post/Cr	30	47.0-57.8	53.89 ± .56	3.06 ± .40	5.68 ± .73
Pt/Ql	32	67.2-80.0	74.16 ± .48	2.74 ± .34	3.69 ± .46
Qw/Ql	32	81.5-90.8	86.43 ± .41	2.34 ± .29	2.71 ± .34
Fe/Hu	29	72.1-74.1	71.17 ± .38	2.03 ± .27	2.85 ± .37
Fe/Ul	28	61.6-68.8	64.45 ± .28	1.46 ± .20	2.27 ± .30
Fe/Cmc	30	123.6-138.1	129.90 ± .64	3.52 ± .45	2.71 ± .35
Ti/Hu	26	111.3-120.3	115.57 ± .45	2.30 ± .30	1.99 ± .28
Ti/Ul	26	100.5-107.7	104.42 ± .38	1.96 ± .27	1.88 ± .26
Ti/Cmc	25	200.0-220.3	210.58 ±1.14	5.69 ± .80	2.70 ± .38
Ta/Hu	32	71.1-79.1	74.98 ± .32	1.79 ± .22	2.39 ± .30
Ta/Ul	32	64.3-70.0	67.67 ± .25	1.39 ± .17	2.05 ± .26
Ta/Cmc	32	128.7-142.2	136.67 ± .63	3.59 ± .45	2.63 ± .33
Ha/Hu	32	29.0-34.2	31.02 ± .18	1.04 ± .13	3.35 ± .32
Ha/Ul	32	26.2-29.6	27.87 ± .15	0.86 ± .11	3.09 ± .39
Ha/Cmc	33	53.4-61.0	56.45 ±..34	1.94 ±..24	3.44 ± .42
Hu/Ul	30	88.3-92.8	90.32 ± .22	1.22 ± .16	1.35 ± .17
Ra/Ul	31	91.4-96.5	95.34 ± .14	0.79 ± .10	0.83 ± .11
Cmc/Ul	30	48.0-51.6	49.60 ± .18	0.96 ± .12	1.94 ± .25
P-1/Ul	32	16.0-18.6	17.15 ± .21	1.21 ± .15	7.06 ± .88
P-2/Ul	31	14.5-16.5	15.74 ± .11	0.64 ± .08	4.14 ± .53
Fe/Ti	26	59.6-63.9	61.29 ± .24	1.22 ± .17	1.98 ± .27
Ta/Ti	27	62.2-67.6	64.85 ± .23	1.21 ± .16	1.87 ± .25
Ha/Ti	27	24.8-27.9	26.73 ± .15	0.80 ± .11	2.99 ± .41

Table 2 (cont.)

Ratios (per cent)

Butorides striatus

Ratio	N	R	M	SD	V
Pre/Sk	4	8.7-11.4	10.53 ± .60	1.20 ± .42	11.40 ± 4.03
Pre/Post	4	52.7-55.0	53.75 ± .53	1.05 ± .37	1.95 ± .69
Pre/Cr	4	28.2-30.9	29.45 ± .57	1.13 ± .40	3.84 ± 1.36
Post/Cr	4	53.4-56.3	54.78 ± .66	1.31 ± .46	2.39 ± .84
Pt/Ql	4	72.6-78.3	75.65 ±1.22	2.44 ± .86	3.23 ± 1.14
Qw/Ql	4	80.0-84.3	81.88 ±1.04	2.08 ± .73	2.54 ± .90
Fe/Hu	3	70.9-74.4	73.17		
Fe/Ul	3	64.3-68.7	66.80		
Fe/Cmc	3	130.1-138.0	134.43		
Ti/Hu	4	105.5-115.9	109.93 ±2.21	4.41 ±1.56	4.01 ± 1.42
Ti/Ul	4	102.6-111.5	106.60 ±1.93	3.86 ±1.36	3.62 ± 1.28
Ti/Cmc	4	195.7-216.4	209.58 ±4.82	9.64 ±3.41	4.60 ± 1.63
Ta/Hu	4	70.0-73.9	71.50 ± .87	1.73 ± .61	2.42 ± .86
Ta/Ul	4	63.6-71.3	66.68 ±1.66	3.32 ±1.17	4.98 ± 1.76
Ta/Cmc	4	128.5-143.3	135.70 ±3.20	6.39 ±2.36	4.71 ± 1.66
Ha/Hu	4	27.8-31.9	30.05 ± .85	1.70 ± .60	5.65 ± 2.00
Ha/Ul	4	25.3-29.5	27.95 ± .93	1.86 ± .66	6.65 ± 2.35
Ha/Cmc	4	51.1-59.2	55.85 ±1.94	3.88 ±1.37	6.82 ± 2.41
Hu/Ul	3	90.6-91.9	91.10		
Ra/Ul	4	94.5-96.2	95.58 ± .25	0.49 ± .17	0.51 ± .18
Cmc/Ul	4	47.4-49.9	49.15 ± .59	1.18 ± .42	2.40 ± .85
P-1/Ul	4	16.4-18.1	17.58 ± .36	0.71 ± .25	4.04 ± 1.43
P-2/Ul	4	14.6-16.0	15.35 ± .31	0.62 ± .22	4.04 ± 1.43
Fe/Ti	3	63.8-64.4	64.87 ±		
Ta/Ti	5	63.2-66.3	64.54 ± .60	1.34 ± .42	2.08 ± .66
Ha/Ti	5	26.1-27.6	27.02 ± .28	0.62 ± .20	2.29 ± .72

Table 2 (cont.)

Ratios (per cent)

Erythocnus rufiventris

Ratio	N	R	M	SD	V
Pre/Sk	3	11.6-12.2	11.93		
Pre/Post	3	51.9-55.3	53.77		
Pre/Cr	3	28.6-29.8	29.27		
Post/Cr	3	53.8-55.2	54.47		
Pt/Ql	3	68.3-72.8	70.37		
Qw/Ql	3	82.4-84.5	83.40		
Fe/Hu	3	69.2-69.8	69.50		
Fe/Ul	2	61.8-62.4	62.10		
Fe/Cmc	2	122.2-124.7	123.45		
Ti/Hu	3	109.0-112.3	110.87		
Ti/Ul	2	97.4-100.2	98.80		
Ti/Cmc	2	194.8-198.3	19.66		
Ta/Hu	3	70.2-72.8	71.17		
Ta/Ul	2	63.0-65.1	64.05		
Ta/Cmc	2	126.0-128.6	127.30		
Ha/Hu	3	26.6-27.7	27.23		
Ha/Ul	2	23.8-24.5	24.15		
Ha/Cmc	2	47.5-48.5	48.00		
Hu/Ul	2	89.4-89.4	89.40		
Ra/Ul	2	94.7-95.6	95.15		
Cmc/Ul	2	50.0-50.6	50.30		
P-1/Ul	2	16.9-17.6	17.25		
P-2/Ul	2	15.5-15.7	15.60		
Fe/Ti	3	61.6-64.0	62.67		
Ta/Ti	3	63.0-64.8	64.17		
Ha/Ti	3	24.4-24.9	24.57		

Table 2 (cont.)

Ratios (per cent)

Florida caerulea

Ratio	N	R	M	SD	V
Pre/Sk	16	9.1-10.7	10.23 ±1.03	0.41 ± .72	4.01 ± .71
Pre/Post	16	44.9-49.6	47.63 ± .34	1.36 ± .24	2.86 ± .51
Pre/Cr	16	25.7-28.5	27.41 ± .21	0.85 ± .15	3.10 ± .55
Post/Cr	16	55.8-61.1	57.56 ± .34	1.36 ± .24	2.36 ± .42
Pt/Ql	16	70.4-79.5	73.72 ± .74	2.97 ± .52	4.03 ± .71
Qw/Ql	16	83.6-89.2	86.67 ± .48	1.92 ± .34	2.22 ± .39
Fe/Hu	16	56.1-59.3	57.58 ± .35	1.38 ± .24	2.40 ± .42
Fe/Ul	16	47.4-50.8	48.82 ± .27	1.09 ± .19	2.23 ± .39
Fe/Cmc	16	98.7-103.4	100.87 ± .42	1.66 ± .29	1.65 ± .29
Ti/Hu	16	132.6-146.7	139.90 ±1.08	4.32 ± .76	3.09 ± .55
Ti/Ul	16	113.0-125.7	118.61 ± .78	3.10 ± .55	2.61 ± .46
Ti/Cmc	16	227.3-258.8	245.12 ±2.08	8.33 ±1.47	3.40 ± .60
Ta/Hu	16	94.9-107.6	102.15 ± .98	3.92 ± .69	3.84 ± .68
Ta/Ul	16	80.7-89.5	86.60 ± .60	2.38 ± .42	2.75 ± .49
Ta/Cmc	16	166.5-185.0	178.95 ±1.56	6.25 ±1.10	3.49 ± .62
Ha/Hu	16	27.2-30.3	28.80 ± .28	1.10 ± .19	3.82 ± .67
Ha/Ul	16	23.0-26.0	24.42 ± .31	1.23 ± .22	5.04 ± .89
Ha/Cmc	16	47.2-54.2	50.46 ± .48	1.92 ± .34	3.80 ± .67
Hu/Ul	16	82.1-86.7	84.81 ± .34	1.36 ± .24	1.60 ± .28
Ra/Ul	16	95.3-96.6	95.83 ± .12	0.49 ± .09	0.51 ± .09
Cmc/Ul	16	46.6-50.6	48.43 ± .26	1.02 ± .18	2.11 ± .37
P-1/Ul	16	16.7-18.7	17.79 ± .15	0.58 ± .10	3.26 ± .58
P-2/Ul	16	12.3-15.6	12.93 ± .20	0.80 ± .15	6.19 ±1.09
Fe/Ti	16	39.4-43.4	41.19 ± .27	1.06 ± .19	2.57 ± .45
Ta/Ti	16	69.5-75.6	73.04 ± .49	1.96 ± .35	2.68 ± .47
Ha/Ti	16	19.1-21.4	20.60 ± .16	0.63 ± .11	3.06 ± .54

Table 2 (cont.)

Ratios (per cent)

Ardeola ralloides

Ratios	N	R	M	SD	V
Pre/Sk	2	10.7-10.7	10.70		
Pre/Post	2	51.9-53.2	52.55		
Pre/Cr	2	28.2-29.2	28.70		
Post/Cr	2	54.3-54.8	54.55		
Pt/Ql	2	71.7-83.3	77.50		
Qw/Ql	2	85.0-85.1	85.05		
Fe/Hu	2	65.3-66.9	66.10		
Fe/Ul	2	56.5-58.3	57.40		
Fe/Gmc	2	118.6-120.8	119.70		
Ti/Hu	2	115.2-117.4	116.30		
Ti/Ul	2	100.4-101.6	101.00		
Ti/Gmc	2	208.1-213.3	210.70		
Ta/Hu	2	73.9-76.2	75.05		
Ta/Ul	2	64.4-65.9	65.15		
Ta/Gmc	2	133.3-138.4	135.85		
Ha/Hu	2	27.3-30.0	28.65		
Ha/Ul	2	23.6-26.1	24.85		
Ha/Gmc	2	49.5-54.1	51.80		
Hu/Ul	2	86.5-87.1	86.80		
Ra/Ul	2	94.9-95.3	95.10		
Gmc/Ul	2	47.6-48.3	47.95		
P-1/Ul	2	16.5-17.8	17.15		
P-2/Ul	2	15.4-16.2	15.80		
Fe/Ti	2	55.6-58.1	56.85		
Ta/Ti	2	64.1-64.9	64.50		
Ha/Ti	2	23.2-26.0	24.60		

Table 2 (cont.)

Ratios (per cent)

Ardeola bacchus

Ratio	N	R	M	SD	V
Pre/Sk	2	12.0-12.2	12.10		
Pre/Post	2	53.7-54.5	54.10		
Pre/Cr	2	29.5-31.2	30.35		
Post/Cr	2	54.2-58.0	56.10		
Pt/Ql	1		72.48		
Qw/Ql	2	81.3-86.2	83.75		
Fe/Hu	2	66.7-68.7	67.70		
Fe/Ul	2	56.6-60.1	58.35		
Fe/Cmc	2	115.9-117.6	116.75		
Ti/Hu	2	114.4-115.4	114.90		
Ti/Ul	2	97.9-100.1	99.00		
Ti/Cmc	2	193.0-203.6	198.30		
Ta/Hu	2	70.8-77.2	74.00		
Ta/Ul	2	61.9-65.5	63.70		
Ta/Cmc	2	119.4-136.2	127.80		
Ha/Hu	2	27.8-28.3	28.05		
Ha/Ul	2	24.1-24.3	24.20		
Ha/Cmc	2	46.9-50.0	48.45		
Hu/Ul	2	84.9-87.5	86.20		
Ra/Ul	1		94.62		
Cmc/Ul	2	48.1-51.9	50.00		
P-1/Ul	2	16.7-17.2	16.95		
P-2/Ul	2	16.5-17.6	17.05		
Fe/Ti	2	57.7-60.1	58.90		
Ta/Ti	2	61.9-66.9	64.40		
Ha/Ti	2	24.3-24.6	24.45		

Table 2 (cont.)

Ratios (per cent)

Ardeola speciosa

Ratio	N	R	M	SD	V
Pre/Sk	1	11.2	11.20		
Pre/Post	1	49.5	49.50		
Pre/Cr	1	29.0	29.00		
Post/Cr	1	58.5	58.50		
Pt/Ql	1	65.8	65.80		
Qw/Ql	1	82.1	82.10		
Fe/Hu	1	69.0	69.00		
Fe/Ul	1	62.1	62.10		
Fe/Cmc	1	128.3	128.30		
Ti/Hu	1	91.3	91.30		
Ti/Ul	1	82.2	82.20		
Ti/Cmc	1	169.8	169.80		
Ta/Hu	1	79.0	79.00		
Ta/Ul	1	71.2	71.20		
Ta/Cmc	1	147.0	147.00		
Ha/Hu	1	30.9	30.90		
Ha/Ul	1	27.9	27.90		
Ha/Cmc	1	57.5	57.50		
Hu/Ul	1	90.1	90.10		
Ra/Ul	1	94.3	94.30		
Cmc/Ul	1	48.4	48.40		
P-1/Ul	1	17.3	17.30		
P-2/Ul	1	17.2	17.20		
Fe/Ti	1	75.6	75.60		
Ta/Ti	1	86.6	86.60		
Ha/Ti	1	33.9	33.90		

Table 2 (cont.)

Ratios (per cent)

Bubulcus ibis

Ratio	N	R	M	SD	V
Pre/Sk	5	10.8-11.9	11.24 ± .21	0.46 ± .15	4.09 ±1.29
Pre/Post	5	43.8-47.2	45.78 ± .73	1.64 ± .52	3.58 ±1.13
Pre/Cr	5	25.9-29.0	27.38 ± .54	1.20 ± .38	4.38 ±1.39
Post/Cr	5	57.4-61.7	59.86 ± .85	1.91 ± .60	3.19 ±1.01
Pt/Ql	6	66.1-78.2	73.22 ±1.71	4.19 ±1.21	5.72 ±1.65
Qw/Ql	6	86.6-91.2	89.20 ± .73	1.80 ± .52	2.02 ± .58
Fe/Hu	5	56.3-61.6	58.80 ± .89	2.00 ± .63	3.40 ±1.08
Fe/Ul	5	48.1-53.0	50.94 ± .88	1.97 ± .62	3.87 ±1.22
Fe/Cmc	5	106.2-115.2	111.00 ±1.69	3.78 ±1.20	3.41 ±1.08
Ti/Hu	5	122.0-137.4	126.08 ±2.86	6.41 ±2.03	5.08 ±1.61
Ti/Ul	5	105.7-108.5	107.22 ± .45	1.00 ± .32	0.93 ± .29
Ti/Cmc	5	232.4-236.0	233.78 ± .59	1.33 ± .42	0.57 ± .18
Ta/Hu	5	85.8-91.4	88.44 ±1.00	2.24 ± .71	2.53 ± .80
Ta/Ul	5	74.8-78.6	76.54 ± .70	1.57 ± .50	2.05 ± .65
Ta/Cmc	5	164.3-170.9	166.90 ±1.27	2.85 ± .90	1.71 ± .54
Ha/Hu	5	28.0-31.0	28.94 ±1.08	2.41 ± .76	8.33 ±2.64
Ha/Ul	5	24.2-26.7	25.04 ± .47	1.06 ± .34	4.23 ±1.34
Ha/Cmc	5	53.0-58.0	54.62 ± .97	2.17 ± .69	3.97 ±1.26
Hu/Ul	5	85.4-87.9	86.56 ± .94	2.10 ± .66	2.43 ± .77
Ra/Ul	5	95.7-96.5	96.04 ± .13	0.30 ± .09	0.31 ± .10
Cmc/Ul	5	45.3-46.1	45.86 ± .14	0.32 ± .10	0.70 ± .22
P-1/Ul	5	16.6-18.5	17.42 ± .31	0.70 ± .22	4.02 ±1.27
P-2/Ul	5	15.5-16.6	16.10-± .20	0.45 ± .14	2.80 ± .89
Fe/Ti	5	45.5-49.0	47.48 ± .65	1.45 ± .46	3.05 ± .97
Ta/Ti	5	70.4-72.4	71.40 ± .42	0.95 ± .30	1.33 ± .42
Ha/Ti	5	22.7-24.6	23.36 ± .37	0.82 ± .26	3.51 ±1.11

Table 2 (cont.)

Ratios (per cent)

Dichromanassa rufescens

Ratio	N	R	M	SD	V
Pre/Sk	4	9.5-10.3	9.88 ± .10	0.20 ± .07	2.02 ± .71
Pre/Post	6	47.5-49.8	48.75 ± .41	1.00 ± .29	2.05 ± .59
Pre/Cr	6	27.3-29.1	27.98 ± .35	0.87 ± .25	3.11 ± .90
Post/Cr	6	55.8-59.3	57.32 ± .55	1.35 ± .39	2.36 ± .68
Pt/Ql	6	71.3-73.5	72.77 ± .27	0.66 ± .19	0.91 ± .26
Qw/Ql	6	83.6-86.4	85.40 ± .40	0.98 ± .28	1.15 ± .33
Fe/Hu	4	55.6-57.4	56.53 ± .23	0.46 ± .16	0.81 ± .29
Fe/Ul	4	46.3-47.4	46.97 ± .37	0.73 ± .26	1.55 ± .55
Fe/Cmc	4	96.4-98.2	97.30 ± .37	0.74 ± .26	0.76 ± .27
Ti/Hu	5	135.9-149.8	142.34 ±2.65	5.94 ±1.88	4.17 ±1.32
Ti/Ul	5	112.6-123.1	118.14 ±1.90	4.26 ±1.35	3.61 ±1.14
Ti/Cmc	5	230.7-258.6	245.22 ±4.78	10.70 ±3.39	4.36 ±1.38
Ta/Hu	4	102.0-120.3	112.58 ±3.71	7.41 ±2.62	6.58 ±2.33
Ta/Ul	4	84.4-99.3	93.70 ±3.23	6.46 ±2.28	6.89 ±2.43
Ta/Cmc	4	175.9-206.0	193.80 ±6.41	12.81 ±4.53	6.61 ±2.34
Ha/Hu	5	22.1-23.3	22.66 ± .23	0.52 ± .16	2.29 ± .72
Ha/Ul	5	18.3-19.1	18.82 ± .15	0.33 ± .10	1.75 ± .55
Ha/Cmc	5	38.1-40.2	39.04 ± .39	0.88 ± .28	2.25 ± .71
Hu/Ul	5	82.2-84.8	83.04 ± .45	1.01 ± .32	1.22 ± .39
Ra/Ul	4	96.1-96.4	96.27 ± .42	0.84 ± .30	0.87 ± .31
Cmc/Ul	5	47.6-48.4	48.20 ± .40	0.90 ± .28	1.87 ± .59
P-1/Ul	5	15.6-16.4	16.10 ± .16	0.35 ± .11	2.17 ± .69
P-2/Ul	5	13.4-14.4	14.00 ± .17	0.37 ± .12	2.64 ± .84
Fe/Ti	4	37.6-41.8	39.60 ± .45	1.79 ± .57	4.52 ±1.43
Ta/Ti	4	81.7-84.5	83.03 ± .67	1.34 ± .47	1.61 ± .57
Ha/Ti	5	15.5-16.6	15.94 ± .19	0.42 ± .13	2.63 ± .83

Table 2 (cont.)

Ratios (per cent)

Casmerodius albus modestus

Ratio	N	R	M	SD	V
Pre/Sk	1	8.8	8.80		
Pre/Post	1	53.4	53.40		
Pre/Cr	1	25.8	25.80		
Post/Cr	1	48.4	48.40		
Pt/Ql	1	58.4	58.40		
Qw/Ql	1	77.0	77.00		
Fe/Hu	1	53.0	53.00		
Fe/Ul	1	44.8	44.80		
Fe/Cmc	1	100.3	100.30		
Ti/Hu	1	134.8	134.80		
Ti/Ul	1	114.1	114.10		
Ti/Cmc	1	255.3	255.30		
Ta/Hu	1	104.8	104.80		
Ta/Ul	1	88.7	88.70		
Ta/Cmc	1	198.5	198.50		
Ha/Hu	1	25.4	25.40		
Ha/Ul	1	21.5	21.50		
Ha/Cmc	1	48.1	48.10		
Hu/Ul	1	84.6	84.60		
Ra/Ul	1	96.2	96.20		
Cmc/Ul	1	44.7	44.70		
P-1/Ul	1	16.5	16.50		
P-2/Ul	1	15.4	15.40		
Fe/Ti	1	39.3	39.30		
Ta/Ti	1	77.7	77.70		
Ha/Ti	1	18.9	18.90		

Table 2 (cont.)

Ratios (per cent)

Casmerodius *albus*

Ratio	N	R	M	SD	V
Pre/Sk	20	7.8- 9.3	8.43 ± .11	0.48 ± .08	5.69 ± .90
Pre/Post	20	51.8-62.6	57.03 ± .62	2.79 ± .44	4.89 ± .77
Pre/Cr	20	23.0-29.0	25.35 ± .34	1.51 ± .24	5.96 ± .94
Post/Cr	20	40.9-47.1	44.46 ± .31	1.40 ± .22	3.15 ± .50
Pt/Ql	20	61.5-71.0	64.56 ± .57	2.54 ± .40	3.93 ± .62
Qw/Ql	20	76.5-83.4	78.77 ± .55	2.45 ± .39	3.11 ± .49
Fe/Hu	20	48.5-58.7	53.39 ± .44	1.97 ± .31	3.69 ± .58
Fe/Ul	18	43.3-46.0	44.62 ± .18	0.77 ± .13	1.73 ± .29
Fe/Cmc	19	97.6-103.1	100.32 ± .48	2.08 ± .34	2.07 ± .34
Ti/Hu	19	122.7-151.5	140.86 ±1.36	5.91 ± .96	4.20 ± .68
Ti/Ul	17	111.4-126.4	117.90 ± .88	3.62 ± .62	3.07 ± .53
Ti/Cmc	18	248.4-278.1	264.53 ±1.74	7.38 ±1.23	2.79 ± .47
Ta/Hu	20	94.9-110.4	105.59 ± .59	4.07 ± .64	3.85 ± .61
Ta/Ul	18	83.2-92.2	88.28 ± .64	2.73 ± .46	3.09 ± .52
Ta/Cmc	19	187.2-207.5	198.78 ±1.43	6.25 ±1.01	3.14 ± .51
Ha/Hu	20	23.3-27.7	25.19 ± .21	0.96 ± .15	3.81 ± .60
Ha/Ul	18	19.8-21.7	21.01 ± .15	0.62 ± .10	2.95 ± .49
Ha/Cmc	19	44.5-51.2	47.27 ± .36	1.57 ± .25	3.32 ± .54
Hu/Ul	18	81.0-85.5	83.51 ± .25	1.06 ± .18	1.27 ± .21
Ra/Ul	18	90.7-97.6	96.07 ± .31	1.30 ± .22	1.35 ± .23
Cmc/Ul	17	42.3-46.2	44.48 ± .17	0.72 ± .12	1.62 ± .28
P-1/Ul	18	15.0-16.1	15.49 ± .10	0.42 ± .07	2.71 ± .45
P-2/Ul	18	13.2-14.2	13.77 ± .08	0.35 ± .06	2.54 ± .42
Fe/Ti	19	35.8-39.6	37.95 ± .21	0.90 ± .15	2.37 ± .38
Ta/Ti	19	71.2-77.4	74.87 ± .41	1.79 ± .29	2.39 ± .39
Ha/Ti	19	16.0-19.2	17.93 ± .17	0.75 ± .12	4.18 ± .68

Table 2 (cont.)

Ratios (per cent)

Egretta garzetta

Ratio	N	R	M	SD	V
Pre/Sk	3	9.6-10.1	9.77		
Pre/Post	4	48.5-50.9	49.80 ± .64	1.28 ± .45	2.57 ± .91
Pre/Cr	3	27.2-28.7	27.73		
Post/Cr	3	55.6-56.4	56.10		
Pt/Ql	4	69.3-73.5	71.75 ± .97	1.93 ± .68	2.69 ± .95
Qw/Ql	4	86.7-88.6	87.30 ± .45	0.90 ± .32	1.03 ± .36
Fe/Hu	6	55.5-60.9	57.68 ± .88	2.17 ± .63	3.76 ±1.08
Fe/Ul	5	46.2-52.1	47.94 ±1.09	2.44 ± .77	5.09 ±1.61
Fe/Cmc	5	101.3-108.6	104.10 ±1.34	3.01 ± .95	2.89 ± .91
Ti/Hu	4	129.2-157.3	143.13 ±4.79	9.57 ±3.38	6.69 ±2.36
Ti/Ul	4	117.9-127.3	122.23 ±2.28	4.55 ±1.61	3.72 ±1.31
Ti/Cmc	4	240.7-269.6	258.67 ±6.43	12.85 ±4.54	4.97 ±1.76
Ta/Hu	5	93.6-103.9	101.06 ±1.75	3.91 ±1.24	3.87 ±1.22
Ta/Ul	5	78.9-87.6	83.50 ±1.65	3.70 ±1.17	4.43 ±1.40
Ta/Cmc	5	173.0-189.0	181.38 ±2.66	5.95 ±1.88	3.28 ±1.04
Ha/Hu	5	25.2-27.0	26.00 ± .34	0.77 ± .24	2.96 ± .94
Ha/Ul	5	20.2-23.6	21.50 ± .56	1.26 ± .40	5.86 ±1.85
Ha/Cmc	5	44.2-49.2	46.72 ± .82	1.83 ± .58	3.92 ±1.24
Hu/Ul	5	75.9-87.4	82.70 ±1.88	4.22 ±1.34	5.10 ±1.61
Ra/Ul	5	95.2-96.6	95.86 ± .29	0.65 ± .21	0.69 ± .22
Cmc/Ul	5	45.1-47.9	46.02 ± .51	1.15 ± .36	2.50 ± .79
P-1/Ul	4	16.3-17.6	16.78 ± .26	0.52 ± .18	3.10 ±1.10
P-2/Ul	4	15.1-16.9	15.60 ± .44	0.87 ± .31	5.58 ±1.97
Fe/Ti	4	37.7-44.1	40.48 ± .39	0.78 ± .28	1.93 ± .68
Ta/Ti	4	66.9-74.6	69.93 ±1.66	3.32 ±1.17	4.75 ±1.68
Ha/Ti	4	17.1-19.7	18.10 ± .63	1.25 ± .44	6.91 ±2.44

Table 2 (cont.)

Ratios (per cent)

Egretta intermedia intermedia

Ratio	N	R	M	SD	V
Pre/Sk	1	10.8	10.80		
Pre/Post	1	51.8	51.80		
Pre/Cr	1	28.4	28.40		
Post/Cr	1	54.8	54.80		
Pt/Ql	1	63.9	63.90		
Qw/Ql	1	83.5	83.50		
Fe/Hu	1	53.0	53.00		
Fe/Ul	1	44.0	44.00		
Fe/Cmc	1	96.3	96.30		
Ti/Hu	1	140.5	140.50		
Ti/Ul	1	116.9	116.90		
Ti/Cmc	1	255.6	255.60		
Ta/Hu	1	104.1	104.10		
Ta/Ul	1	86.5	86.50		
Ta/Cmc	1	189.3	189.30		
Ha/Hu	1	28.9	28.90		
Ha/Ul	1	24.0	24.00		
Ha/Cmc	1	52.6	52.60		
Hu/Ul	1	83.2	83.20		
Ra/Ul	1	96.0	96.00		
Cmc/Ul	1	45.7	45.70		
P-1/Ul	1	15.8	15.80		
P-2/Ul	1	14.0	14.00		
Fe/Ti	1	37.7	37.70		
Ta/Ti	1	74.0	74.00		
Ha/Ti	1	20.6	20.60		

Table 2 (cont.)

Ratios (per cent)

Leucophoyx thula

Ratio	N	R	M	SD	V
Pre/Sk	12	9.2-11.1	9.88 ± .19	0.66 ± .14	6.68 ± 1.36
Pre/Post	12	45.5-47.7	48.17 ± .62	2.14 ± .44	4.44 ± .91
Pre/Cr	11	27.0-29.8	28.12 ± .26	0.86 ± .18	3.06 ± .65
Post/Cr	11	55.7-60.1	58.17 ± .48	1.61 ± .34	2.77 ± .59
Pt/Ql	11	66.4-81.5	76.21 ±1.35	4.47 ± .95	5.87 ± 1.25
Qw/Ql	11	82.5-89.5	86.20 ± .61	2.04 ± .43	2.37 ± .51
Fe/Hu	11	55.4-60.0	57.37 ± .50	1.65 ± .35	2.88 ± .61
Fe/Ul	11	46.4-50.1	47.97 ± .34	1.14 ± .24	2.38 ± .51
Fe/Cmc	11	96.3-107.6	102.24 ±1.03	3.43 ± .73	3.35 ± ..71
Ti/Hu	10	137.0-145.0	140.68 ±1.12	3.56 ± .79	2.53 ± .56
Ti/Ul	11	113.9-122.6	[illegible]	2.88 ± .61	2.46 ± .52
Ti/Cmc	11	238.9-270.4	249.73 ±2.80	9.31 ±1.99	3.73 ± .80
Ta/Hu	9	101.4-105.1	102.71 ± .89	2.68 ± .63	2.61 ± .61
Ta/Ul	10	83.5-93.9	86.41 ± .92	2.94 ± .66	3.40 ± .76
Ta/Cmc	10	177.3-206.3	184.73 ±2.53	8.06 ±1.80	4.36 ± .97
Ha/Hu	10	23.4-29.0	26.66 ± .48	1.52 ± .34	5.70 ± 1.27
Ha/Ul	11	21.1-24.8	22.40 ± .22	0.74 ± .16	3.30 ± .70
Ha/Cmc	11	45.2-51.4	47.74 ± .71	2.37 ± .51	4.96 ± 1.06
Hu/Ul	11	82.2-84.5	83.26 ± .37	1.22 ± .26	1.47 ± .31
Ra/Ul	12	95.3-97.1	96.11 ± .28	0.97 ± .20	1.01 ± .21
Cmc/Ul	12	45.3-48.4	46.94 ± .34	1.17 ± .24	2.49 ± .51
P-1/Ul	12	15.7-17.0	16.29 ± .13	0.45 ± .09	2.76 ± .56
P-2/Ul	12	14.3-15.6	14.93 ± .13	0.45 ± .09	3.01 ± ..61
Fe/Ti	12	39.2-43.2	41.05 ± .40	1.39 ± .28	3.39 ± .69
Ta/Ti	11	69.9-80.2	74.00 ± .85	2.82 ± .60	3.81 ± .81
Ha/Ti	12	17.6-21.2	19.15 ± .26	0.89 ± .18	4.65 ± .95

Table 2 (cont.)

Ratios (per cent)

Hydranassa tricolor

Ratio	N	R	M	SD	V
Pre/Sk	14	8.2- 9.2	8.79 ± .14	0.52 ± .10	5.92 ±1.12
Pre/Post	16	49.8-58.5	55.26 ± .66	2.62 ± .46	4.74 ± .84
Pre/Cr	15	24.5-28.2	26.91 ± .29	1.14 ± .21	4.24 ± .77
Post/Cr	15	44.8-52.7	48.80 ± .56	2.17 ± .40	4.45 ± .81
Pt/Ql	14	71.5-79.7	74.87 ± .57	2.15 ± .41	2.87 ± .54
Qw/Ql	16	71.5-79.7	92.02 ± .79	3.14 ± .55	3.41 ± .60
Fe/Hu	17	57.6-60.0	58.95 ± .30	1.22 ± .21	2.07 ± .35
Fe/Ul	15	48.4-51.0	49.76 ± .22	0.87 ± .16	1.75 ± .32
Fe/Cmc	16	97.6-105.3	101.55 ± .70	2.81 ± .50	2.77 ± .49
Ti/Hu	15	124.9-146.0	137.47 ±1.39	5.36 ± .98	3.90 ± .71
Ti/Ul	14	105.3-124.8	115.91 ±1.42	5.30 ±1.00	4.57 ± .86
Ti/Cmc	15	213.5-257.6	236.91 ±2.84	11.01 ±2.01	4.65 ± .85
Ta/Hu	14	93.3-108.3	103.32 ±1.43	5.36 ±1.01	5.19 ± .98
Ta/Ul	13	77.9-92.1	87.14 ±1.36	4.92 ± .96	5.65 ±1.11
Ta/Cmc	14	161.3-189.9	178.10 ±2.46	9.20 ±1.74	5.17 ± .98
Ha/Hu	16	27.1-29.7	28.39 ± .26	1.03 ± .18	3.63 ± .64
Ha/Ul	15	23.0-25.4	24.03 ± .22	0.85 ± .16	3.54 ± .66
Ha/Cmc	16	47.8-52.5	48.94 ± .40	1.59 ± .28	3.25 ± .57
Hu/Ul	15	82.9-85.5	84.37 ± .14	0.53 ± .10	0.63 ± .11
Ra/Ul	15	94.9-96.5	95.65 ± .20	0.79 ± .14	0.83 ± .15
Cmc/Ul	15	47.8-50.9	48.89 ± .24	0.93 ± .17	1.90 ± .35
P-1/Ul	15	16.4-18.0	17.58 ± .11	0.41 ± .07	2.33 ± .43
P-2/Ul	15	12.6-15.4	13.29 ± .17	0.66 ± .12	4.97 ± .91
Fe/Ti	15	40.8-46.1	42.92 ± .38	1.48 ± .27	3.45 ± .63
Ta/Ti	14	70.0-77.7	75.20 ± .53	1.98 ± .37	2.63 ± .50
Ha/Ti	15	19.0-22.6	20.72 ± .25	0.97 ± .18	4.68 ± .85

Table 2 (cont.)

Ratios (per cent)

Syrigma sibilatrix

Ratio	N	R	M	SD	V
Pre/Sk	1	11.3	11.30		
Pre/Post	1	46.1	46.10		
Pre/Cr	1	27.2	27.20		
Post/Cr	1	59.0	59.00		
Pt/Ql	1	72.3	72.30		
Qw/Ql	1	94.9	94.90		
Fe/Hu	1	54.1	54.10		
Fe/Ul	1	45.3	45.30		
Fe/Cmc	1	93.7	93.70		
Ti/Hu	1	116.5	116.50		
Ti/Ul	1	97.7	97.70		
Ti/Cmc	1	201.9	201.90		
Ta/Hu	1	85.1	85.10		
Ta/Ul	1	71.3	71.30		
Ta/Cmc	1	147.5	147.50		
Ha/Hu	1	27.0	27.00		
Ha/Ul	1	22.7	22.70		
Ha/Cmc	1	46.9	46.90		
Hu/Ul	1	83.8	83.80		
Ra/Ul	1	95.7	95.70		
Cmc/Ul	1	48.4	48.40		
P-1/Ul	1	17.5	17.50		
P-2/Ul	1	14.8	14.80		
Fe/Ti	1	46.4	46.40		
Ta/Ti	1	73.0	73.00		
Ha/Ti	1	23.2	23.20		

Table 2 (cont.)

Ratios (per cent)

Nycticorax nycticorax nycticorax

Ratio	N	R	M	SD	V
Pre/Sk	4	12.7-13.1	12.85 ± .09	0.17 ± .06	1.32 ± .47
Pre/Post	5	46.4-53.0	48.00 ±1.26	2.82 ±1.00	5.88 ±2.08
Pre/Cr	4	30.0-31.6	30.73 ± .30	0.60 ± .21	1.95 ± .69
Post/Cr	4	56.6-66.9	63.85 ±2.45	4.89 ±1.73	7.66 ±2.71
Pt/Ql	5	59.2-65.8	62.54 ±1.31	2.93 ± .93	4.69 ±1.48
Qw/Ql	4	78.7-82.8	80.58 ± .98	1.95 ± .69	2.42 ± .86
Fe/Hu	4	63.4-66.7	64.85 ± .69	1.37 ± .48	2.11 ± .75
Fe/Ul	4	56.6-59.3	57.63 ± .52	1.04 ± .37	1.80 ± .64
Fe/Cmc	4	116.0-123.2	119.65 ±1.47	2.94 ±1.04	2.46 ± .87
Ti/Hu	4	107.8-112.4	109.85 ± .95	1.90 ± .67	1.73 ± .61
Ti/Ul	4	96.3-98.8	97.55 ± .52	1.04 ± .37	1.07 ± .37
Ti/Cmc	4	196.8-206.7	202.65 ±2.25	4.50 ±1.59	2.22 ± .78
Ta/Hu	4	67.9-72.8	70.50 ±1.01	2.01 ± .71	2.85 ±1.01
Ta/Ul	4	60.7-64.8	62.63 ± .81	1.62 ± .57	2.59 ± .92
Ta/Cmc	4	126.3-133.4	130.05 ±1.48	2.96 ±1.05	2.28 ± .81
Ha/Hu	4	23.8-25.1	24.70 ± .53	1.05 ± .37	4.25 ±1.50
Ha/Ul	4	21.3-22.3	21.93 ± .12	0.24 ± .08	1.09 ± .39
Ha/Cmc	4	44.7-46.9	45.55 ± .48	0.96 ± .34	2.11 ± .75
Hu/Ul	4	87.9-89.4	88.85 ± .33	0.66 ± .23	0.74 ± .26
Ra/Ul	4	95.2-96.0	95.62 ± .45	0.89 ± .31	0.93 ± .33
Cmc/Ul	4	46.9-49.5	48.18 ± .57	1.14 ± .40	2.37 ± .84
P-1/Ul	4	15.5-17.5	16.38 ± .40	0.79 ± .28	4.82 ±1.70
P-2/Ul	4	13.9-15.3	14.65 ± .35	0.70 ± .25	4.78 ±1.69
Fe/Ti	4	57.6-60.9	59.05 ± .86	1.71 ± .60	2.90 ±1.02
Ta/Ti	4	62.7-66.5	64.20 ± .86	1.72 ± .60	2.68 ± .95
Ha/Ti	4	22.1-22.9	22.47 ± .28	0.55 ± .19	2.23 ± .79

Table 2 (cont.)

Ratios (per cent)

Nycticorax nycticorax hoactli

Ratio	N	R	M	SD	V
Pre/Sk	40	12.0-13.9	13.08 ± .07	0.47 ± .05	3.59 ± .40
Pre/Post	40	43.0-51.1	47.03 ± .26	1.66 ± .19	3.53 ± .39
Pre/Cr	39	29.2-32.3	30.85 ± .19	1.17 ± .13	3.79 ± .43
Post/Cr	36	60.0-68.8	65.68 ± .37	2.22 ± .26	3.38 ± .40
Pt/Ql	39	59.8-68.8	64.36 ± .38	2.39 ± .27	3.71 ± .42
Qw/Ql	41	75.1-86.7	81.12 ± .45	2.87 ± .32	3.54 ± .39
Fe/Hu	33	58.8-67.4	64.81 ± .32	1.83 ± .23	2.82 ± .35
Fe/Ul	31	56.4-62.2	59.26 ± .27	1.52 ± .19	2.56 ± .32
Fe/Cmc	32	112.2-125.2	117.81 ± .57	3.24 ± .41	2.75 ± .34
Ti/Hu	30	96.0-114.9	108.96 ± .71	3.91 ± .50	3.59 ± .46
Ti/Ul	29	95.5-103.0	99.51 ± .44	2.39 ± .31	2.40 ± .31
Ti/Cmc	30	187.4-210.5	197.88 ± .98	5.36 ± .69	2.71 ± .35
Ta/Hu	37	61.8-76.6	70.64 ± .45	2.75 ± .32	3.89 ± .45
Ta/Ul	36	61.4-68.6	64.44 ± .33	1.97 ± .23	3.06 ± .36
Ta/Cmc	37	122.5-134.9	128.37 ± .49	2.99 ± .35	2.33 ± .27
Ha/Hu	34	23.0-28.2	25.12 ± .23	1.37 ± .17	5.45 ± .66
Ha/Ul	34	21.7-25.6	22.95 ± .22	1.28 ± .16	5.58 ± .68
Ha/Cmc	35	41.9-50.5	45.76 ± .29	1.69 ± .20	3.69 ± .44
Hu/Ul	35	88.8-92.8	90.93 ± .19	1.10 ± .13	1.21 ± .14
Ra/Ul	37	94.5-97.0	95.63 ± .12	0.75 ± .09	0.78 ± .09
Cmc/Ul	36	47.9-54.0	50.26 ± .18	1.07 ± .13	2.13 ± .25
P-1/Ul	37	16.7-19.2	17.85 ± .09	0.57 ± .07	3.19 ± .37
P-2/Ul	35	13.4-16.9	15.52 ± .14	0.80 ± .10	5.15 ± .62
Fe/Ti	30	57.7-62.3	59.60 ± .21	1.16 ± .15	1.95 ± .25
Ta/Ti	31	61.5-67.8	64.98 ± .45	2.50 ± .32	3.85 ± .49
Ha/Ti	32	21.5-25.2	23.12 ± .17	0.96 ± .12	4.15 ± .52

Table 2 (cont.)

Ratios (per cent)

Nycticorax caledonicus

Ratio	N	R	M	SD	V
Pre/Sk	1	12.5	12.50		
Pre/Post	1	44.8	44.80		
Pre/Cr	1	29.5	29.50		
Post/Cr	1	65.9	65.90		
Pt/Ql	1	64.8	64.80		
Qw/Ql	1	79.3	79.30		
Fe/Hu	1	65.6	65.60		
Fe/Ul	1	59.4	59.40		
Fe/Cmc	1	119.1	119.10		
Ti/Hu	1	113.6	113.60		
Ti/Ul	1	102.9	102.90		
Ti/Cmc	1	206.4	206.40		
Ta/Hu	1	74.8	74.80		
Ta/Ul	1	67.8	67.80		
Ta/Cmc	1	135.9	135.90		
Ha/Hu	1	25.6	25.60		
Ha/Ul	1	23.2	23.20		
Ha/Cmc	1	46.5	46.50		
Hu/Ul	1	90.6	90.60		
Ra/Ul	1	95.5	95.50		
Cmc/Ul	1	49.9	49.90		
P-1/Ul	1	17.5	17.50		
P-2/Ul	1	15.2	15.20		
Fe/Ti	1	57.7	57.70		
Ta/Ti	1	65.9	65.90		
Ha/Ti	1	22.5	22.50		

Table 2 (cont.)

Ratios (per cent)

Nyctanassa violacea violacea

Ratio	N	R	M	SD	V
Pre/Sk	19	12.3-13.5	12.87 ± .17	0.72 ± .12	5.59 ± .91
Pre/Post	19	42.6-47.4	44.99 ± .42	1.84 ± .30	4.09 ± .66
Pre/Cr	19	28.1-31.0	29.39 ± .27	1.17 ± .19	3.98 ± .65
Post/Cr	19	61.1-69.1	65.12 ± .46	1.99 ± .32	3.06 ± .50
Pt/Ql	18	55.8-65.4	62.03 ± .68	2.89 ± .48	4.66 ± .78
Qw/Ql	18	76.9-88.5	83.93 ± .67	2.86 ± .48	3.41 ± .57
Fe/Hu	19	58.9-62.1	60.42 ± .15	0.66 ± .11	1.09 ± .18
Fe/Ul	18	49.9-53.5	52.13 ± .25	1.05 ± .18	2.01 ± .34
Fe/Cmc	18	105.9-112.7	108.57 ± .53	2.24 ± .37	2.06 ± .34
Ti/Hu	19	121.4-135.0	126.42 ± .88	3.74 ± .62	2.96 ± .49
Ti/Ul	18	105.0-115.2	108.89 ± .56	2.38 ± .40	2.19 ± .37
Ti/Cmc	18	217.9-239.1	226.92 ±1.46	6.18 ±1.03	2.72 ± .45
Ta/Hu	19	89.3-99.6	92.64 ± .55	2.39 ± .39	2.58 ± .42
Ta/Ul	18	75.6-83.2	79.77 ± .42	1.80 ± .30	2.26 ± .38
Ta/Cmc	18	159.6-176.9	166.27 ± .85	3.62 ± .60	2.18 ± .36
Ha/Hu	19	20.9-23.1	22.19 ± .15	0.67 ± .11	3.02 ± .49
Ha/Ul	18	19.1-20.4	19.20 ± .23	0.99 ± .17	5.16 ± .86
Ha/Cmc	18	34.3-42.2	39.66 ± .42	1.76 ± .29	4.44 ± .74
Hu/Ul	18	83.6-89.0	86.31 ± .33	1.39 ± .23	1.61 ± .27
Ra/Ul	18	94.3-96.3	95.55 ± .22	0.94 ± .16	0.98 ± .16
Cmc/Ul	17	46.5-49.0	48.02 ± .12	0.51 ± .09	1.06 ± .18
P-1/Ul	18	16.2-18.4	17.26 ± .17	0.73 ± .12	4.23 ± .71
P-2/Ul	18	12.9-15.9	14.58 ± .17	0.73 ± .12	5.01 ± .84
Fe/Ti	19	44.1-49.7	47.83 ± .31	1.37 ± .22	2.86 ± .46
Ta/Ti	19	69.0-76.4	73.30 ± .45	1.97 ± .32	2.69 ± .44
Ha/Ti	19	16.5-18.9	17.62 ± .15	0.66 ± .11	3.75 ± .61

Table 2 (cont.)

Ratios (per cent)

Nyctanassa violacea bancrofti

Ratio	N	R	M	SD	V
Pre/Sk	1	12.5	12.50		
Pre/Post	2	46.2-49.4	47.80		
Pre/Cr	2	28.8-31.6	30.20		
Post/Cr	2	62.4-63.9	63.15		
Pt/Ql	2	57.9-60.7	59.30		
Qw/Ql	2	84.2-84.7	84.45		
Fe/Hu	2	61.8-62.7	62.25		
Fe/Ul	2	51.4-54.0	52.70		
Fe/Cmc	2	107.2-114.1	110.65		
Ti/Hu	2	124.4-135.9	130.15		
Ti/Ul	2	103.5-117.1	110.30		
Ti/Cmc	2	215.8-247.4	231.60		
Ta/Hu	2	95.6-97.5	96.55		
Ta/Ul	2	79.5-84.0	81.75		
Ta/Cmc	2	165.8-177.5	171.65		
Ha/Hu	2	22.4-23.1	22.75		
Ha/Ul	2	18.6-19.9	19.25		
Ha/Cmc	2	38.9-42.0	40.45		
Hu/Ul	2	83.2-86.2	84.70		
Ra/Ul	2	95.9-96.0	95.95		
Cmc/Ul	2	47.3-48.0	47.65		
P-1/Ul	2	13.7-14.2	13.95		
P-2/Ul	2	17.7-18.4	18.05		
Fe/Ti	2	46.1-49.7	47.90		
Ta/Ti	2	71.8-76.8	74.35		
Ha/Ti	2	17.0-18.0	17.50		

Table 2 (cont.)

Ratios (per cent)

Gorsachius melanolophus

Ratio	N	R	M	SD	V
Pre/Sk	1	13.3	13.30		
Pre/Post	1	43.1	43.10		
Pre/Cr	1	27.1	27.10		
Post/Cr	1	62.8	62.80		
Pt/Ql	1	70.1	70.10		
Qw/Ql	1	92.4	92.40		
Fe/Hu	1	60.8	60.80		
Fe/Ul	1	52.2	52.20		
Fe/Cmc	1	109.2	109.20		
Ti/Hu	1	107.4	107.40		
Ti/Ul	1	92.1	92.10		
Ti/Cmc	1	192.8	192.80		
Ta/Hu	1	71.8	71.80		
Ta/Ul	1	61.6	61.60		
Ta/Cmc	1	128.9	128.90		
Ha/Hu	1	22.5	22.50		
Ha/Ul	1	19.3	19.30		
Ha/Cmc	1	40.3	40.30		
Hu/Ul	1	85.8	85.80		
Ra/Ul	1	96.2	96.20		
Cmc/Ul	1	47.8	47.80		
P-1/Ul	1	16.6	16.60		
P-2/Ul	1	13.3	13.30		
Fe/Ti	1	56.6	56.60		
Ta/Ti	1	66.9	66.90		
Ha/Ti	1	20.9	20.90		

Table 2 (cont.)

Ratios (per cent)

Tigriornis leucolopha

Ratio	N	R	M	SD	V
Pre/Sk	2	10.3-10.8	10.55		
Pre/Post	2	52.4-56.5	54.45		
Pre/Cr	2	27.2-29.5	28.35		
Post/Cr	2	51.8-52.3	52.05		
Pt/Ql	2	76.3-80.9	78.60		
Qw/Ql	2	81.6-84.2	82.90		
Fe/Hu	2	80.8-81.3	81.05		
Fe/Ul	2	69.0-71.0	70.00		
Fe/Cmc	2	157.4-161.9	159.65		
Ti/Hu	2	125.2-129.6	127.40		
Ti/Ul	2	110.0-110.0	110.00		
Ti/Cmc	2	243.9-258.1	251.00		
Ta/Hu	2	84.0-84.3	84.15		
Ta/Ul	2	71.6-73.8	72.70		
Ta/Cmc	2	163.6-168.0	165.80		
Ha/Hu	2	29.2-29.4	29.30		
Ha/Ul	2	24.9-25.6	25.25		
Ha/Cmc	2	56.8-58.5	57.65		
Hu/Ul	2	84.9-87.9	86.40		
Ra/Ul	2	94.0-94.6	94.30		
Cmc/Ul	2	42.6-45.1	43.85		
P-1/Ul	2	15.3-16.3	15.80		
P-2/Ul	2	11.5-11.8	11.65		
Fe/Ti	2	62.8-64.6	63.70		
Ta/Ti	2	65.1-67.1	66.10		
Ha/Ti	2	22.7-23.3	23.00		

Table 2 (cont.)

Ratios (per cent)

Tigrisoma lineatum

Ratio	N	R	M	SD	V
Pre/Sk	4	9.0-10.5	10.23 ± .41	0.82 ± .29	8.02 ±2.83
Pre/Post	5	44.9-53.2	48.98 ±1.56	3.49 ±1.10	7.13 ±2.26
Pre/Cr	5	25.0-28.8	27.30 ± .66	1.47 ± .47	5.38 ±1.70
Post/Cr	5	53.1-57.9	55.84 ± .82	1.84 ± .58	3.30 ±1.04
Pt/Ql	4	63.9-71.2	68.18 ±1.77	3.53 ±1.25	5.18 ±1.83
Qw/Ql	5	81.9-92.8	86.40 ±1.96	4.39 ±1.39	5.08 ±1.61
Fe/Hu	5	72.8-77.2	75.10 ± .76	1.70 ± .54	2.26 ± .72
Fe/Ul	4	61.4-64.3	63.05 ± .70	1.39 ± .49	2.20 ± .78
Fe/Cmc	5	133.7-141.9	139.24 ±1.43	3.21 ±1.02	2.31 ± .73
Ti/Hu	4	124.0-131.0	126.78 ±1.42	2.83 ±1.00	2.23 ± .79
Ti/Ul	3	106.4-108.7	107.47		
Ti/Cmc	4	230.3-240.7	234.05 ±2.35	4.69 ±1.66	2.00 ± .71
Ta/Hu	4	88.8-95.0	91.23 ±1.31	2.62 ± .93	2.87 ±1.01
Ta/Ul	3	76.4-78.9	77.47		
Ta/Cmc	4	164.9-174.5	168.40 ±2.13	4.25 ±1.50	2.52 ± .89
Ha/Hu	4	25.9-29.8	27.85 ± .83	1.66 ± .59	5.96 ±2.11
Ha/Ul	3	21.5-24.0	22.90		
Ha/Cmc	4	47.6-55.3	51.24 ±1.63	3.26 ±1.15	6.34 ±2.24
Hu/Ul	4	83.0-85.1	84.18 ± .23	0.45 ± .16	0.53 ± .19
Ra/Ul	4	93.8-95.1	94.62 ± .50	1.00 ± .35	1.06 ± .37
Cmc/Ul	4	44.7-45.9	45.43 ± .10	0.20 ± .07	0.44 ± .16
P-1/Ul	3	15.1-16.3	15.50		
P-2/Ul	3	12.0-12.6	12.37		
Fe/Ti	4	57.7-61.2	59.45 ± .74	1.48 ± .52	2.49 ± .88
Ta/Ti	4	71.2-72.5	71.95 ± .33	0.66 ± .23	0.92 ± .33
Ha/Ti	4	19.8-24.0	22.00 ± .88	1.75 ± .62	7.95 ±2.81

Table 2 (cont.)

Ratios (per cent)

Tigrisoma mexicana

Ratio	N	R	M	SD	V
Pre/Sk	8	8.7-10.3	9.45 ± .20	0.56 ± .14	5.93 ±1.48
Pre/Post	7	44.5-49.7	47.72 ± .73	1.95 ± .52	4.09 ±1.09
Pre/Cr	8	23.4-26.8	25.34 ± .34	0.96 ± .24	3.79 ± .95
Post/Cr	7	50.6-55.2	52.84 ± .64	1.71 ± .46	3.24 ± .87
Pt/Ql	8	67.0-75.3	71.84 ±1.02	2.89 ± .72	4.02 ±1.01
Qw/Ql	8	83.9-88.6	87.09 ± .55	1.55 ± .39	1.78 ± .45
Fe/Hu	8	66.5-72.8	70.46 ± .87	2.46 ± .62	3.49 ± .87
Fe/Ul	7	58.0-62.1	59.24 ± .58	1.55 ± .41	2.62 ± .70
Fe/Cmc	7	128.9-135.1	131.54 ±3.18	8.49 ±2.27	6.45 ±1.72
Ti/Hu	7	121.4-130.0	126.63 ±1.07	2.85 ± .76	2.25 ± .60
Ti/Ul	7	102.7-108.6	105.44 ± .89	2.37 ± .63	2.25 ± .60
Ti/Cmc	7	229.1-238.2	234.53 ±1.17	3.13 ± .84	1.33 ± .36
Ta/Hu	8	87.0-91.8	87.84 ± .98	2.78 ± .70	3.16 ± .79
Ta/Ul	8	72.2-75.1	73.91 ± .37	1.06 ± .27	1.43 ± .36
Ta/Cmc	8	159.9-166.6	163.89 ± .72	2.03 ± .51	1.24 ± .31
Ha/Hu	8	26.2-30.0	28.16 ± .45	1.28 ± .32	4.55 ±1.14
Ha/Ul	8	22.9-25.1	23.73 ± .25	0.72 ± .18	3.03 ± .76
Ha/Cmc	8	50.9-55.0	52.57 ± .19	0.54 ± .14	1.03 ± .26
Hu/Ul	8	81.0-90.7	84.20 ±1.07	3.02 ± .76	3.59 ± .90
Ra/Ul	8	93.8-96.9	95.05 ± .35	0.98 ± .25	1.03 ± .26
Cmc/Ul	8	44.3-46.0	45.09 ± .21	0.59 ± .15	1.31 ± .33
P-1/Ul	8	14.7-16.4	15.66 ± .21	0.59 ± .15	3.77 ± .94
P-2/Ul	8	12.9-14.1	13.46 ± .18	0.52 ± .13	3.86 ± .97
Fe/Ti	6	55.1-57.2	56.27 ± .33	0.80 ± .23	1.42 ± .41
Ta/Ti	7	67.8-72.0	70.00 ± .55	1.46 ± .39	2.09 ± .56
Ha/Ti	7	21.6-23.9	22.47 ± .32	0.85 ± .23	3.78 ±1.01

Table 2 (cont.)

Ratios (per cent)

Ixobrychus sinensis

Ratio	N	R	M	SD	V
Pre/Sk	1	10.3	10.30		
Pre/Post	1	57.6	57.60		
Pre/Cr	1	27.0	27.00		
Post/Cr	1	46.8	46.80		
Pt/Ql	1	68.0	68.10		
Qw/Ql	1	81.3	81.30		
Fe/Hu	1	85.3	85.30		
Fe/Ul	0				
Fe/Cmc	1	163.5	163.50		
Ti/Hu	1	131.2	131.20		
Ti/Ul	0				
Ti/Cmc	1	251.3	251.30		
Ta/Hu	1	87.3	87.30		
Ta/Ul	0				
Ta/Cmc	1	167.3	167.30		
Ha/Hu	1	35.5	35.50		
Ha/Ul	0				
Ha/Cmc	1	68.1	68.10		
Hu/Ul	0				
Ra/Ul	0				
Cmc/Ul	0				
P-1/Ul	0				
P-2/Ul	0				
Fe/Ti	1	65.1	65.10		
Ta/Ti	1	66.6	66.60		
Ha/Ti	1	27.1	27.10		

Table 2 (cont.)

Ratios (per cent)

Ixobrychus involucris

Ratio	N	R	M	SD	V
Pre/Sk	1	10.0	10.00		
Pre/Post	1	53.2	53.20		
Pre/Cr	1	26.4	26.40		
Post/Cr	1	49.7	49.70		
Pt/Ql	1	84.6	84.60		
Qw/Ql	1	80.2	80.20		
Fe/Hu	1	90.0	90.90		
Fe/Ul	1	87.0	87.00		
Fe/Cmc	1	175.4	175.40		
Ti/Hu	1	153.0	153.00		
Ti/Ul	1	133.1	133.10		
Ti/Cmc	1	268.4	268.40		
Ta/Hu	1	87.0	87.00		
Ta/Ul	1	83.3	83.30		
Ta/Cmc	1	168.0	168.00		
Ha/Hu	1	35.8	35.80		
Ha/Ul	1	34.3	34.30		
Ha/Cmc	1	69.1	69.10		
Hu/Ul	1	95.7	95.70		
Ra/Ul	1	95.9	95.90		
Cmc/Ul	1	49.6	49.60		
P-1/Ul	1	18.0	18.00		
P-2/Ul	1	16.1	16.10		
Fe/Ti	1	65.4	65.40		
Ta/Ti	1	62.6	62.60		
Ha/Ti	1	25.8	25.80		

Table 2 (cont.)

Ratios (per cent)

Ixobrychus exilis

Ratio	N	R	M	SD	V
Pre/Sk	9	10.3-11.3	10.74 ± .14	0.41 ± .10	3.82 ± .90
Pre/Post	10	52.3-56.3	54.35 ± .45	1.41 ± .32	2.59 ± .58
Pre/Cr	10	25.5-28.3	26.73 ± .29	0.88 ± .20	3.29 ± .74
Post/Cr	10	47.6-50.3	49.28 ± .32	1.01 ± .23	2.05 ± .46
Pt/Ql	9	65.6-75.4	69.86 ± .76	2.28 ± .54	3.26 ± .77
Qw/Ql	10	77.2-83.8	80.53 ± .71	2.25 ± .71	2.25 ± .62
Fe/Hu	11	87.2-90.6	88.98 ± .35	1.15 ± .25	1.29 ± .28
Fe/Ul	10	84.0-90.0	86.61 ± .55	1.75 ± .39	2.02 ± .45
Fe/Cmc	10	161.3-174.0	170.49 ±1.20	3.78 ± .85	2.22 ± .50
Ti/Hu	10	135.6-141.0	138.30 ± .54	1.71 ± .38	1.24 ± .28
Ti/Ul	10	131.8-138.0	134.35 ± .68	2.16 ± .48	1.61 ± .36
Ti/Cmc	9	254.4-275.1	265.53 ±2.13	6.38 ±1.50	2.40 ± .57
Ta/Hu	9	86.6-89.5	88.18 ± .31	0.93 ± .22	1.05 ± .25
Ta/Ul	9	83.0-87.9	85.63 ± .52	1.55 ± .37	1.81 ± .43
Ta/Cmc	8	167.1-175.1	170.66 ± .94	2.66 ± .67	1.56 ± .39
Ha/Hu	10	35.0-38.7	36.68 ± .36	1.12 ± .25	3.05 ± .68
Ha/Ul	10	34.3-37.5	35.69 ± .34	1.06 ± .24	2.97 ± .66
Ha/Cmc	10	67.7-74.5	70.32 ± .61	1.92 ± .43	2.73 ± .61
Hu/Ul	11	95.2-99.4	97.15 ± .42	1.41 ± .30	1.45 ± .31
Ra/Ul	10	94.0-95.4	94.66 ± .15	0.48 ± .11	0.51 ± .11
Cmc/Ul	10	49.5-52.5	50.76 ± .30	0.96 ± .21	1.89 ± .42
P-1/Ul	10	16.3-17.7	17.13 ± .12	0.39 ± .09	2.28 ± .51
P-2/Ul	10	13.8-16.1	15.51 ± .25	0.79 ± .18	5.09 ±1.14
Fe/Ti	10	62.4-66.2	64.36 ± .37	1.17 ± .26	1.82 ± .41
Ta/Ti	8	62.0-65.4	63.88 ± .39	1.09 ± .27	1.71 ± .43
Ha/Ti	9	25.1-28.4	26.66 ± .33	0.98 ± .23	3.68 ± .87

Table 2 (cont.)

Ratios (per cent)

Ixobrychus cinnamomeus

Ratio	N	R	M	SD	V
Pre/Sk	1	13.5	13.50		
Pre/Post	1	60.3	60.30		
Pre/Cr	1	32.3	32.30		
Post/Cr	1	53.5	53.50		
Pt/Ql	1	60.8	60.80		
Qw/Ql	1	75.8	75.80		
Fe/Hu	1	83.0	83.00		
Fe/Ul	1	76.9	76.90		
Fe/Cmc	1	144.6	144.60		
Ti/Hu	1	130.2	130.20		
Ti/Ul	1	120.7	120.70		
Ti/Cmc	1	227.0	227.00		
Ta/Hu	1	82.3	82.30		
Ta/Ul	1	76.3	76.30		
Ta/Cmc	1	143.4	143.40		
Ha/Hu	1	34.0	34.00		
Ha/Ul	1	31.5	31.50		
Ha/Cmc	1	59.3	59.30		
Hu/Ul	1	92.7	92.70		
Ra/Ul	1	92.5	92.50		
Cmc/Ul	1	53.2	53.20		
P-1/Ul	1	17.5	17.50		
P-2/Ul	1	15.6	15.60		
Fe/Ti	1	63.7	63.70		
Ta/Ti	1	63.2	63.20		
Ha/Ti	1	26.1	26.10		

Table 2 (cont.)

Ratios (per cent)

Ixobrychus strumii

Ratio	N	R	M	SD	V
Pre/Sk	1	12.8	12.80		
Pre/Post	1	49.7	49.70		
Pre/Cr	1	27.4	27.40		
Post/Cr	1	55.1	55.10		
Pt/Ql					
Qw/Ql	1	90.9	90.90		
Fe/Hu	1	72.7	72.70		
Fe/Ul	1	67.4	67.40		
Fe/Cmc	1	129.2	129.20		
Ti/Hu	1	111.8	111.80		
Ti/Ul	1	104.6	104.60		
Ti/Cmc	1	198.6	198.60		
Ta/Hu	1	69.7	69.70		
Ta/Cmc	1	123.8	123.80		
Ha/Hu	1	30.5	30.50		
Ha/Ul	1	28.2	28.20		
Ha/Cmc	1	54.1	54.10		
Hu/Ul	1	92.6	92.60		
Ra/Ul	1	95.1	95.10		
Cmc/Ul	1	52.1	52.10		
P-1/Ul	1	17.9	17.90		
P-2/Ul	1	16.4	16.40		
Fe/Ti	1	65.1	65.10		
Ta/Ti	1	62.3	62.30		
Ha/Ti	1	27.6	27.60		

Table 2 (cont.)

Ratios (per cent)

Botaurus stellaris

Ratio	N	R	M	SD	V
Pre/Sk	3	13.1-13.3	13.20		
Pre/Post	3	56.3-62.4	58.87		
Pre/Cr	3	29.3-30.6	29.77		
Post/Cr	3	49.0-52.1	50.57		
Pt/Ql	3	64.3-68.0	66.33		
Qw/Ql	3	75.9-78.0	77.07		
Fe/Hu	3	73.3-75.4	74.07		
Fe/Ul	3	67.1-69.3	67.90		
Fe/Cmc	3	133.5-138.4	135.27		
Ti/Hu	3	114.9-116.7	115.63		
Ti/Ul	3	105.3-106.8	106.03		
Ti/Cmc	3	209.5-212.6	211.30		
Ta/Hu	3	72.8-74.1	73.40		
Ta/Ul	3	67.0-67.9	67.33		
Ta/Cmc	3	133.6-135.1	134.17		
Ha/Hu	3	27.2-28.5	27.80		
Ha/Ul	3	24.9-26.2	25.50		
Ha/Cmc	3	49.6-52.4	50.83		
Hu/Ul	3	91.5-91.9	91.70		
Ra/Ul	3	95.3-95.7	95.43		
Cmc/Ul	3	50.0-50.3	50.17		
P-1/Ul	3	15.5-17.4	16.20		
P-2/Ul	2	13.3-14.5	13.90		
Fe/Ti	3	62.8-65.4	64.03		
Ta/Ti	3	62.9-64.5	63.53		
Ha/Ti	3	23.7-24.7	24.03		

Table 2 (cont.)

Ratios (per cent)

Botaurus lentiginosus

Ratio	N	R	M	SD	V
Pre/Sk	15	11.0-13.3	12.14 ± .16	0.60 ± .11	4.94 ± .90
Pre/Post	14	54.5-62.9	58.33 ± .84	3.15 ± .60	5.40 ±1.02
Pre/Cr	15	25.9-32.8	29.33 ± .76	2.95 ± .54	10.06 ±1.84
Post/Cr	18	47.4-54.9	50.45 ± .48	2.04 ± .34	4.04 ± .67
Pt/Ql	19	59.2-69.6	63.96 ± .74	3.22 ± .52	5.03 ± .81
Qw/Ql	19	72.2-81.6	79.59 ± .75	3.25 ± .53	4.08 ± .66
Fe/Hu	17	71.3-75.4	73.13 ± .35	1.45 ± .25	1.98 ± .34
Fe/Ul	16	64.4-69.7	66.86 ± .47	1.88 ± .33	2.81 ± .50
Fe/Cmc	17	121.0-133.4	127.40 ± .73	2.99 ± .51	2.35 ± .40
Ti/Hu	17	114.3-122.5	118.27 ± .44	1.80 ± .31	1.52 ± .26
Ti/Ul	17	105.1-112.7	108.37 ± .54	2.23 ± .38	2.06 ± .35
Ti/Cmc	18	195.6-215.9	205.89 ±1.31	5.55 ± .93	2.70 ± .45
Ta/Hu	17	75.1-86.4	80.78 ± .71	2.94 ± .50	3.64 ± .62
Ta/Ul	17	69.9-79.1	74.15 ± .50	2.07 ± .36	2.79 ± .48
Ta/Cmc	18	133.2-151.4	140.90 ±1.32	5.58 ± .93	3.96 ± .66
Ha/Hu	18	30.3-34.1	32.03 ± .21	0.91 ± .15	2.84 ± .47
Ha/Ul	18	27.6-31.5	29.44 ± .31	1.31 ± .22	4.45 ± .74
Ha/Cmc	19	53.2-59.2	55.98 ± .45	1.95 ± .32	3.48 ± .56
Hu/Ul	17	89.8-93.7	91.56 ± .33	1.35 ± .23	1.47 ± .25
Ra/Ul	18	94.2-96.1	95.06 ± .23	1.00 ± .17	1.05 ± .18
Cmc/Ul	18	51.3-53.2	52.46 ± .13	0.57 ± .10	1.09 ± .18
P-1/Ul	18	15.1-19.1	17.31 ± .18	0.77 ± .13	4.45 ± .74
P-2/Ul	15	12.4-15.2	14.11 ± .18	0.69 ± .13	4.89 ± .89
Fe/Ti	16	59.6-64.2	61.95 ± .33	1.33 ± .23	2.15 ± .38
Ta/Ti	17	66.6-71.3	68.72 ± .38	1.58 ± .27	2.30 ± .39
Ha/Ti	18	25.8-29.5	27.24 ± .27	1.14 ± .19	4.19 ± .70

Table 2 (cont.)

Ratios (per cent)

Cochlearius cochlearius

Ratio	N	R	M	SD	V
Pre/Sk	2	15.8-17.7	16.75		
Pre/Post	2	50.7-58.4	54.55		
Pre/Cr	2	35.2-41.0	38.10		
Post/Cr	2	69.4-70.3	69.85		
Pt/Ql	2	63.9-68.9	66.40		
Qw/Ql	2	93.8-95.8	94.80		
Fe/Hu	2	69.7-79.3	74.50		
Fe/Ul	2	59.5-62.4	60.95		
Fe/Gmc	2	135.1-136.9	136.00		
Ti/Hu	2	119.9-129.5	124.70		
Ti/Ul	2	105.8-110.6	108.20		
Ti/Cmc	2	232.1-251.0	241.55		
Ta/Hu	2	78.0-86.9	82.45		
Ta/Ul	2	68.9-74.3	71.60		
Ta/Gmc	2	151.0-168.6	159.80		
Ha/Hu	1		26.95		
Ha/Ul	1		23.02		
Ha/Cmc	1		52.24		
Hu/Ul	2	85.4-88.2	86.80		
Ra/Ul	2	94.3-94.9	94.60		
Cmc/Ul	2	44.1-45.6	44.85		
P-1/Ul	2	17.1-17.5	17.30		
P-2/Ul	2	13.9-15.5	14.70		
Fe/Ti	2	53.8-59.0	56.40		
Ta/Ti	2	65.1-67.2	66.15		
Ha/Ti	1		20.81		

Explanation of Plate 1
Qualitative Osteological Characters

1. Internasal Septum
    - A. Absent
    - I. Intermediate
    - P. Present
2. Supraorbital Vacuities
    - 0. No vacuities
    - 2. Two vacuities
    - 4. Four vacuities
3. Ectethmoid
    - B. Bridged
    - S. Separate
4. Lacrimal
    - P. Parallel
    - E. Angulate, entire
    - N. Angulate, notched
5. Inferior Hypocleidial Process
    - T. Truncate
    - N. Notched
    - A. Absent
6. Articular Surface of Carina
    - F. Broad, flat
    - P. Sharply pointed
7. Intramuscular line of Coracoid
    - M. Medial
    - L. Lateral
8. Tendinal Groove of Carpometacarpus
    - E. Enlarged
    - R. Reduced
9. Tibia-fibula
    - A. Ankylosed
    - N. Not ankylosed
10. Hypotarsus
    - 1. One canal
    - 2. Two canals
    - 3. Three canals
11. Superior Hypocleidial Process
    - S. Spatulate
    - P. Pointed
    - A. Absent
12. Sternal Facet of Coracoid
    - L. Lateral
    - M. Medial

SPECIES	1			2			3		4			5			6		7		8		9		10			11			12	
	A	I	P	O	2	4	B	S	P	E	N	T	N	A	F	P	M	L	E	R	A	N	I	2	3	S	P	A	L	M
ARDEA SUMATRANA	A				2			S	P			T			F		M		E			N	I			S			L	
GOLIATH	A				2			S	P			T			F		M		E		A		I			S			L	
MELANOCEPHALA	A				2			S	P			T			F		M		E			N	I			S			L	
CINEREA	A				2		B		P			T			F		M		E		A		I			S			L	
HERODIAS	A				2		B		P			T			F		M		E			N	I			S			L	
OCCIDENTALIS	A				2		B		P			T			F		M		E			N	I			S			L	
COCOI	A				2			S	P			T			F		M		E			N	I			S			L	
PACIFICA	A				2			S			N	T			F		M		E			N		2			P		L	
PURPUREA	A				2			S	P			T			F		M		E			N		2			P		L	
PILHERODIUS PILEATUS			P		2		B				N		N			P	M			R		N		2		S			L	
BUTORIDES VIRESCENS	A				2			S			N	T			F		M		E			N	I				P		L	
STRIATUS	A				2			S			N	T			F		M		E			N	I				P		L	
ERYTHOCNUS RUFIVENTRIS	A				2			S			N		N			P		L		R		N	I				P		L	
FLORIDA CAERULEA			P		2			S			N	T			F		M			R		N			3	S			L	
ARDEOLA RALLOIDES	A				2			S			N	T			F		M			R		N		2			P		L	
BACCHUS	A				2			S			N	T			F		M			R		N		2			P		L	
SPECIOSA	A				2			S			N	T			F		M			R		N		2			P		L	
BUBULCUS IBIS		I			2			S			N	T			F		M		E		A			2			P		L	
DICHROMANASSA RUFESCENS	A				2			S			N		N			P	M			R		N		2		S			L	
CASMERODIUS ALBUS		I			2			S	P			T			F		M			R	A		I			S				M
EGRETTA GARZETTA		I			2			S			N	T			F		M		E			N	I			S				M
INTERMEDIA		I			2			S			N	T			F		M		E		A			2		S				M
LEUCOPHOYX THULA			P		2			S			N	T			F		M		E			N	I			S			L	
HYDRANASSA TRICOLOR	A				2			S			N	T			F		M		E			N	I			S			L	
SYRIGMA SIBILATRIX		I			2		B				N		N			P	M			R		N	I				P		L	
NYCTICORAX NYCTICORAX			P			4	B			E			N			P	M		E			N	I			S			L	
CALEDONICUS			P			4	B			E			N			P	M		E		A			2		S			L	
NYATANASSA VIOLACEA		I		O				S			N		N			P	M			R	A		I			S			L	
GORSACHIUS MELANOLOPHUS		I			2			S			N		N			P	M		E		A			2		S			L	
TIGRIORNIS LEUCOLOPHA			P			4		S			N			A		P		L	E			N	I					A	L	
TIGRISOMA LINEATUM		I		O				S	P					A		P		L	E			N		2				A	L	
MEXICANA		I		O				S	P					A		P		L	E			N		2				A	L	
IXOBRYCHUS SINENSIS		I			2			S			N		N			P		L		R		N		2			P		L	
INVOLUCRIS		I			2			S			N		N			P		L		R		N		2			P		L	
EXILIS		I			2			S			N		N			P		L		R		N		2			P		L	
CINNAMOMEUS		I			2			S			N		N			P		L		R		N		2			P		L	
STRUMII		I			2			S			N		N			P		L		R		N		2			P		L	
BOTAURUS STELLARIS		I			2			S			N		N			P		L	E			N		2			P		L	
LENTIGINOSUS		I			2			S			N		N			P		L	E			N		2			P		L	
COCHLEARIUS COCHLEARIUS			P	O				S			N		N			P		L		R		N	I			S			L	

PLATE I. QUALITATIVE OSTEOLOGICAL CHARACTERS

Explanation of Plate 2
Ratios

1. *Ardea sumatrana*
2. *Ardea goliath*
3. *Ardea melanocephala*
4. *Ardea cinerea*
5. *Ardea herodias*
6. *Ardea occidentalis*
7. *Ardea cocoi*
8. *Ardea pacifica*
9. *Ardea purpurea*
10. *Pilherodias pileatus*
11. *Butorides virescens*
12. *Butorides striatus*
13. *Erythocnus rufiventris*
14. *Florida caerulea*
15. *Ardeola ralloides*
16. *Ardeola bacchus*
17. *Ardeola speciosa*
18. *Bubulcus ibis*
19. *Dichromanassa rufescens*
20. *Casmerodius albus*
21. *Egretta garzetta*
22. *Egretta intermedia*
23. *Leucophoyx thula*
24. *Hydranassa tricolor*
25. *Syrigma sibilatrix*
26. *Nycticorax nycticorax*
27. *Nycticorax caledonicus*
28. *Nyctanassa violacea*
29. *Gorsachius melanolophus*
30. *Tigriornis leucolopha*
31. *Tigrisoma lineatum*
32. *Tigrisoma mexicana*
33. *Ixobrychus sinensis*
34. *Ixobrychus involucris*
35. *Ixobrychus exilis*
36. *Ixobrychus cinnamomeus*
37. *Ixobrychus strumii*
38. *Botaurus stellaris*
39. *Botaurus lentiginosus*
40. *Cochlearius cochlearius*

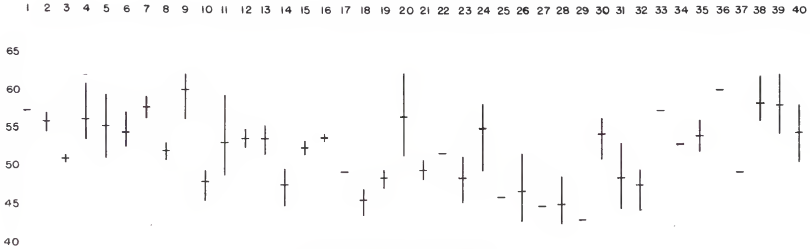

FIG. 2. PREORBITAL/POSTORBITAL

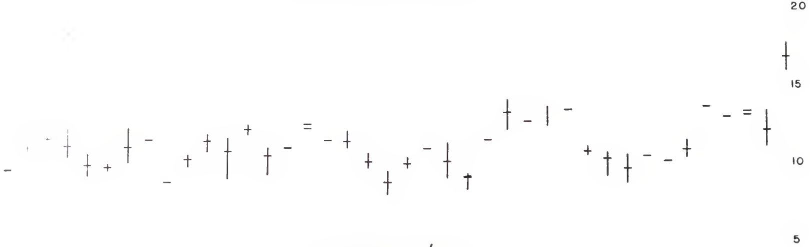

FIG. 1. PREORBITAL/SKULL

PLATE 2. RATIOS

MEAN, RANGE IN PER CENT

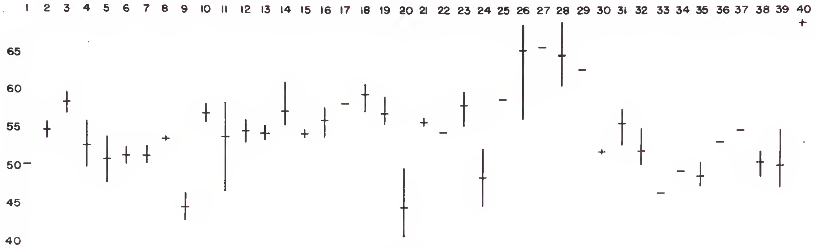

FIG. 4. POSTORBITAL/CRANIUM

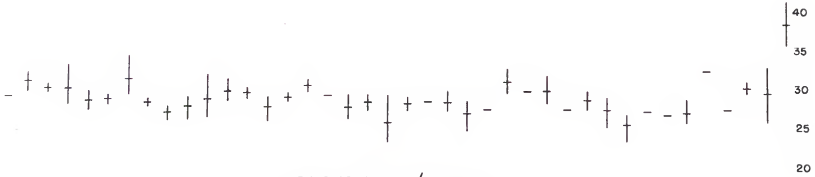

FIG. 3. PREORBITAL/CRANIUM

PLATE 2. RATIOS (CONT.)

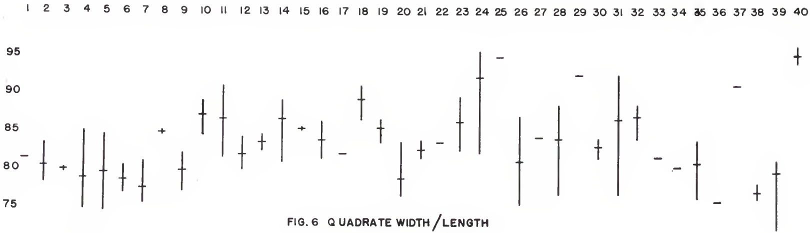

FIG. 6 QUADRATE WIDTH/LENGTH

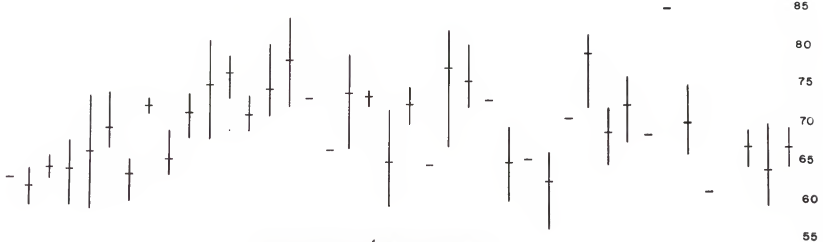

FIG. 5 PTERYGOID/QUADRATE LENGTH

PLATE 2. RATIOS (CONT.)

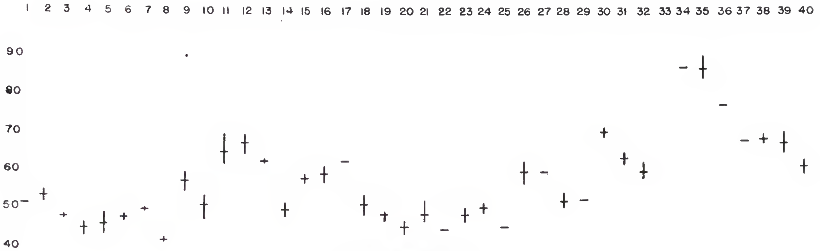

FIG. 8 FEMUR/ULNA

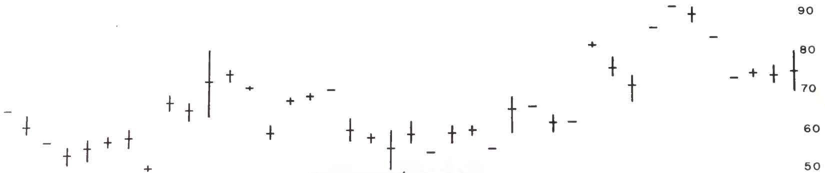

FIG. 7 FEMUR/HUMERUS

PLATE 2. RATIOS (CONT.)

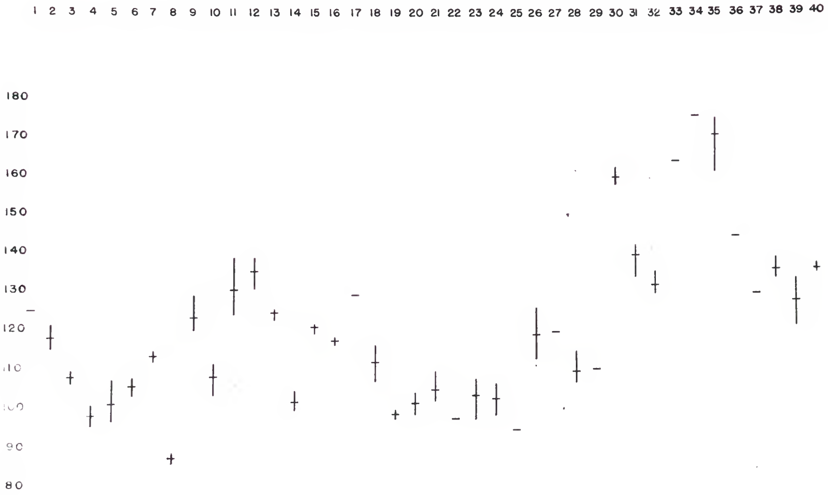

FIG. 9 FEMUR/CARPOMETACARPUS
PLATE 2. RATIOS (CONT.)

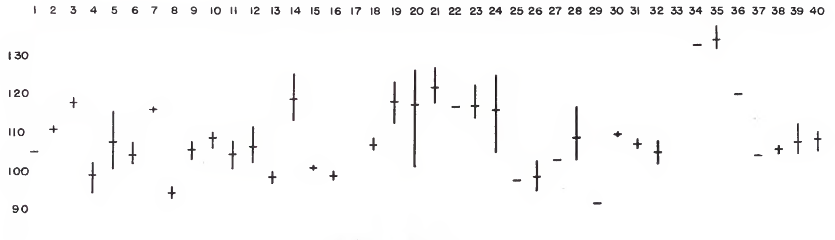

FIG. 11 TIBIA/ULNA

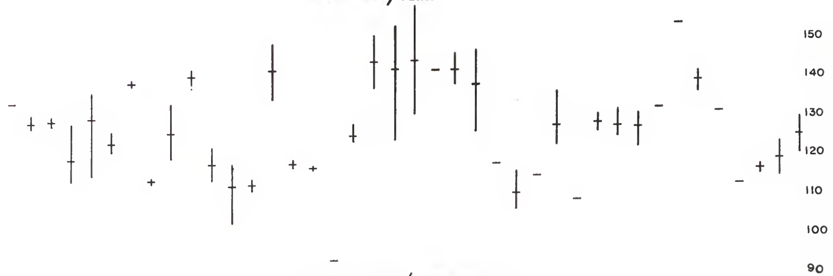

FIG. 10 TIBIA/HUMERUS

PLATE 2. RATIOS (CONT.)

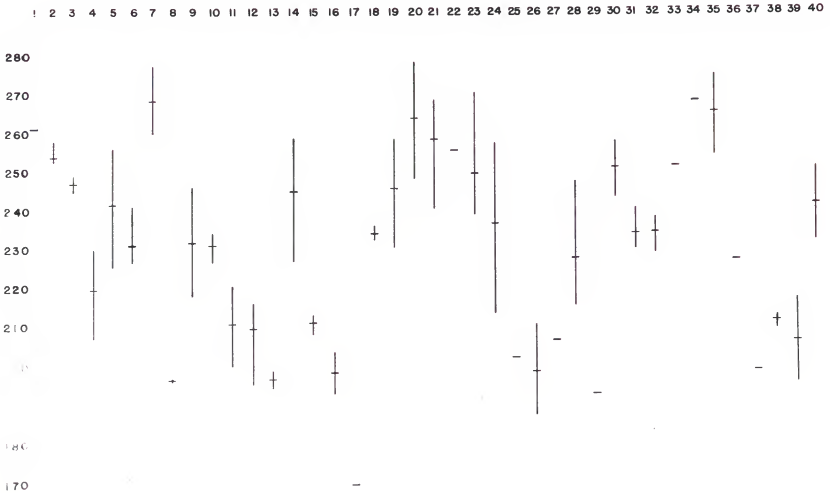

FIG. 12 TIBIA/CARPOMETACARPUS
PLATE 2. RATIOS (CONT.)

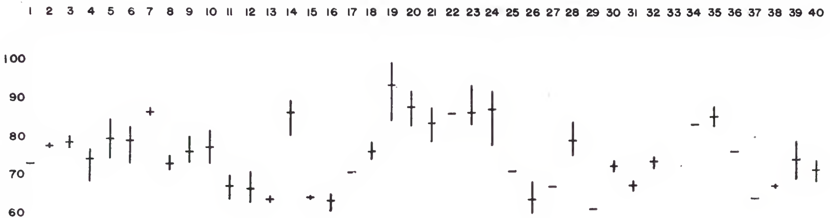

FIG. 14 TIBIA/ULNA

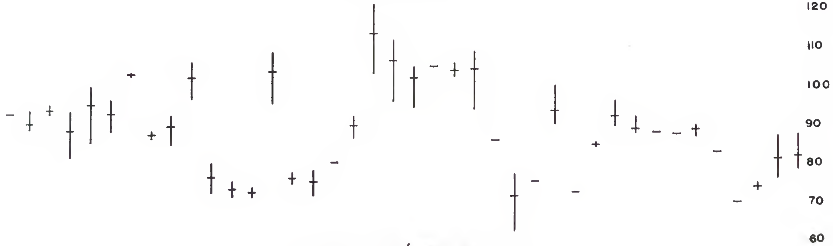

FIG. 13 TIBIA/HUMERUS

PLATE 2. RATIOS (CONT.)

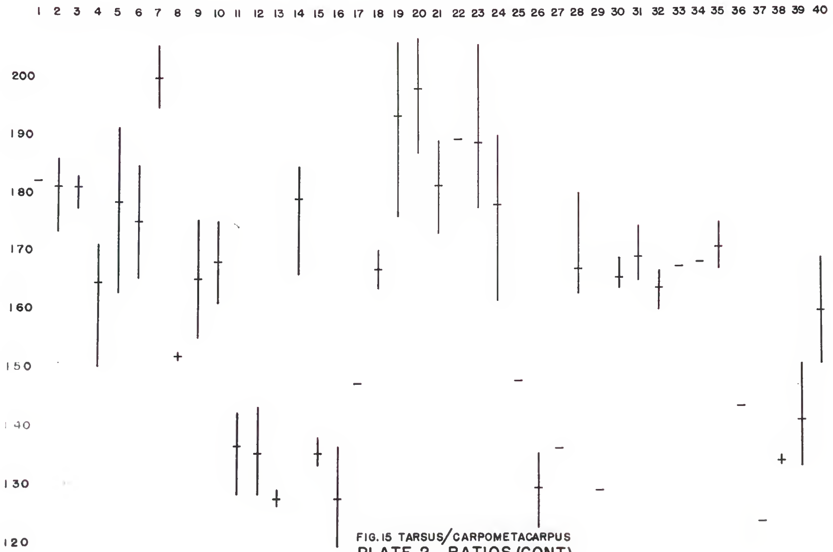

FIG. 15 TARSUS/CARPOMETACARPUS
PLATE 2. RATIOS (CONT.)

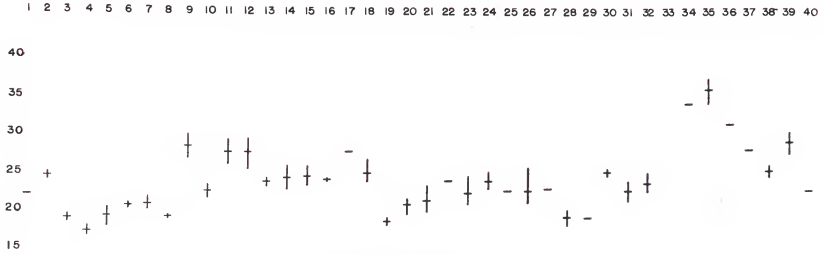

FIG. 17 HALLUX/ULNA

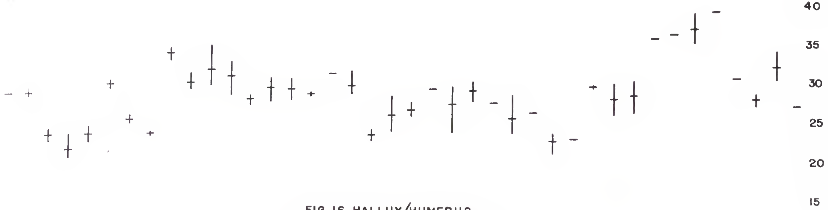

FIG. 16 HALLUX/HUMERUS

PLATE 2. RATIOS (CONT.)

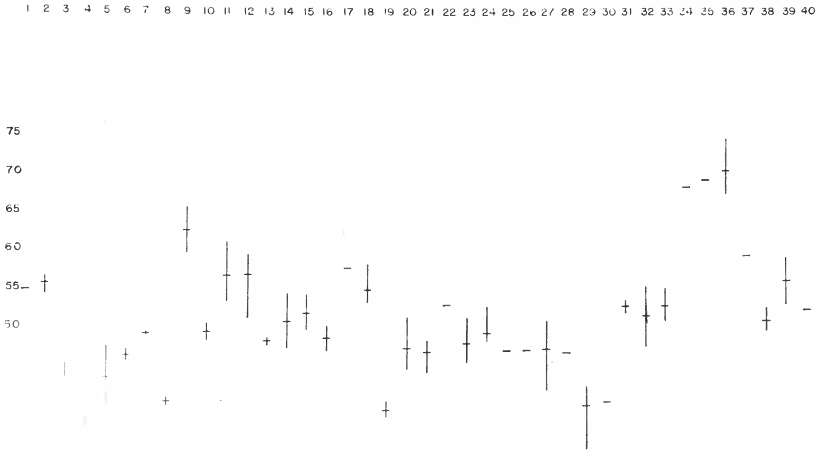

FIG. 18 HALLUX/CARPOMETACARPUS

PLATE 2. RATIOS (CONT.)

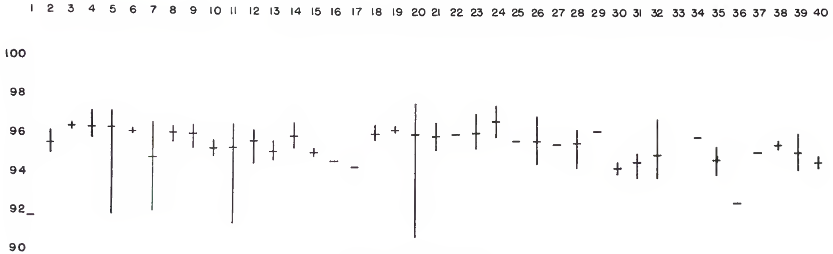

FIG. 20 RADIUS/ULNA

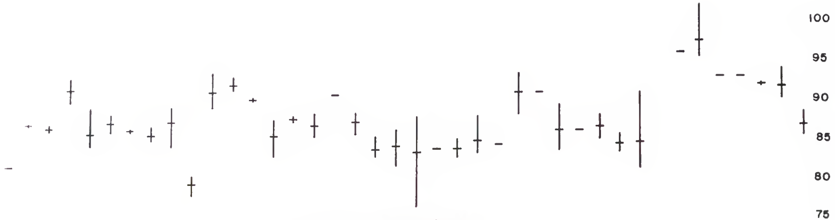

FIG. 19 HUMERUS/ULNA

PLATE 2. RATIOS (CONT.)

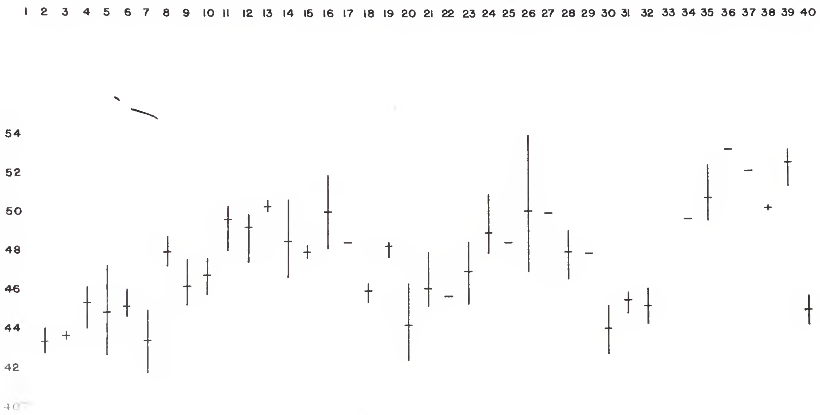

FIG. 21 CARPOMETACARPUS/ULNA
PLATE 2. RATIOS (CONT.)

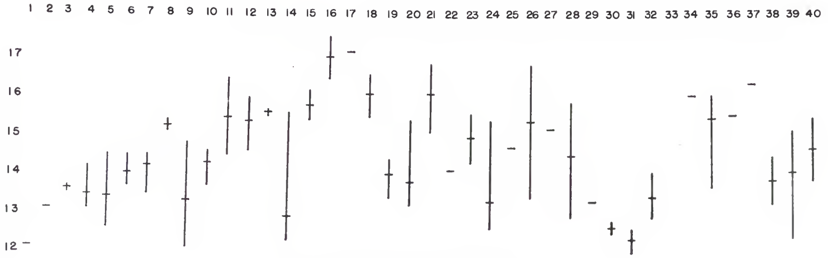

FIG. 23 DIGIT 2, PHALANX 2/ULNA

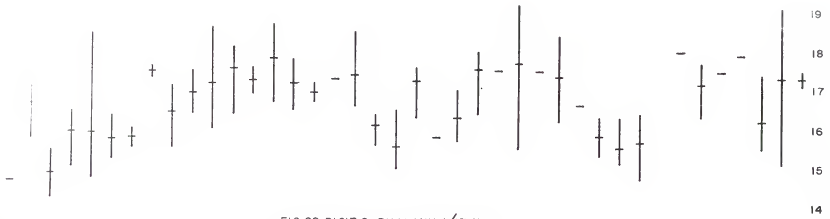

FIG. 22 DIGIT 2, PHALANX 1/ULNA

PLATE 2. RATIOS (CONT.)

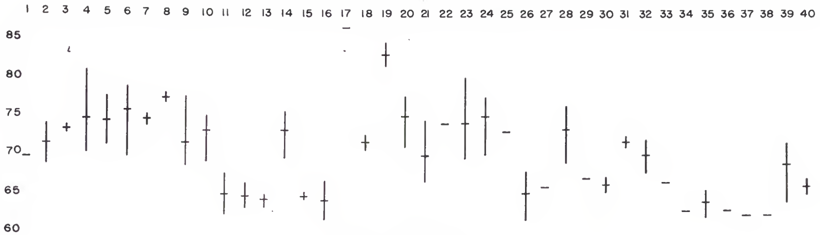

FIG. 25 TARSUS/TIBIA

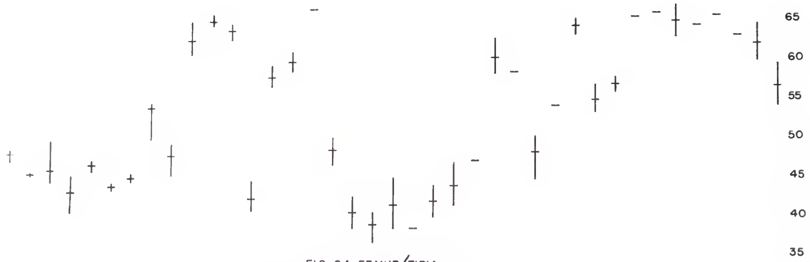

FIG. 24 FEMUR/TIBIA

PLATE 2. RATIOS (CONT.)

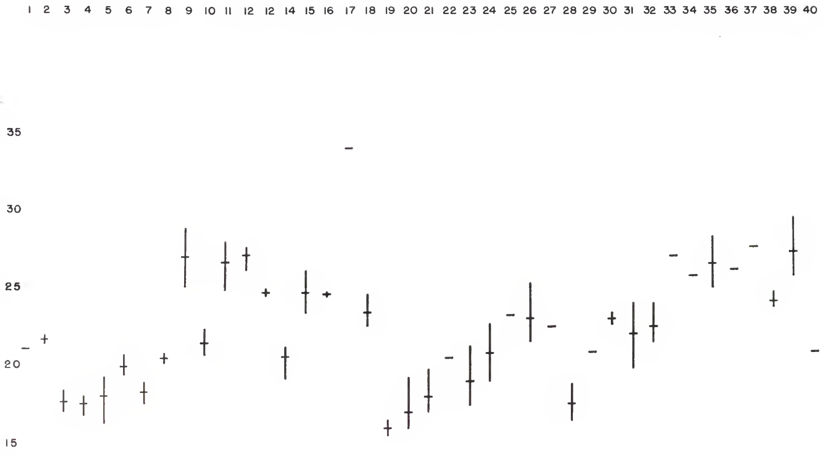

FIG. 26 HALLUX/TIBIA

PLATE 2. RATIOS (CONT.)

Plate 3

Hypothetical Phylogenetic Tree

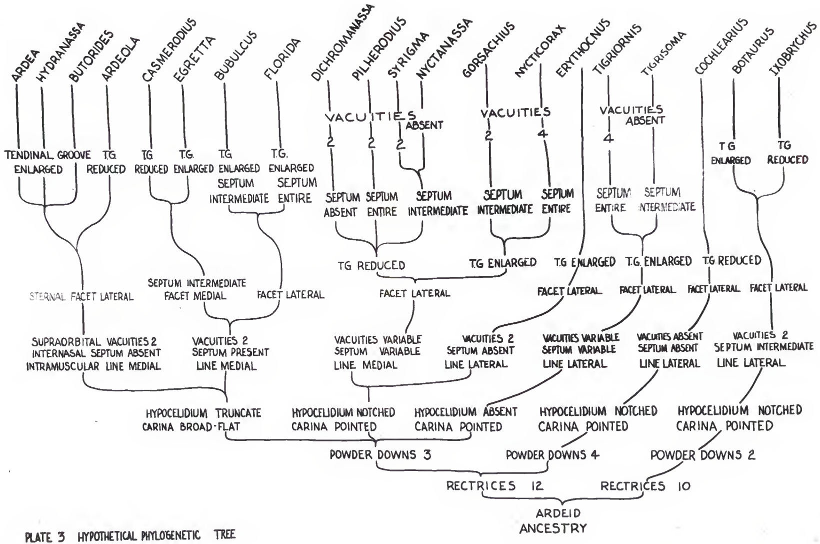

PLATE 3 HYPOTHETICAL PHYLOGENETIC TREE

Plate 4

Subfamily Ardeinae

Tribe Ardeae

Ardea cinerea

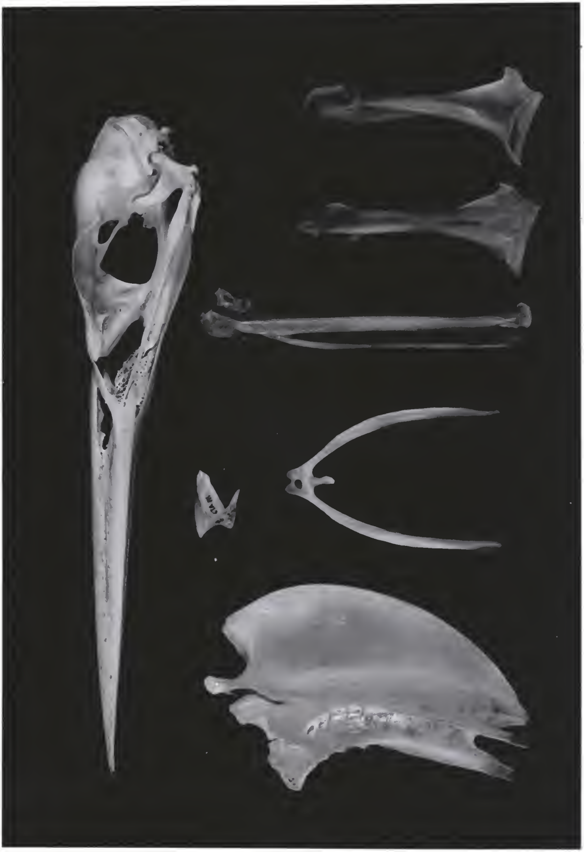

Plate 5

Subfamily Ardeinae

Tribe Egrettae

Casmerodius albus

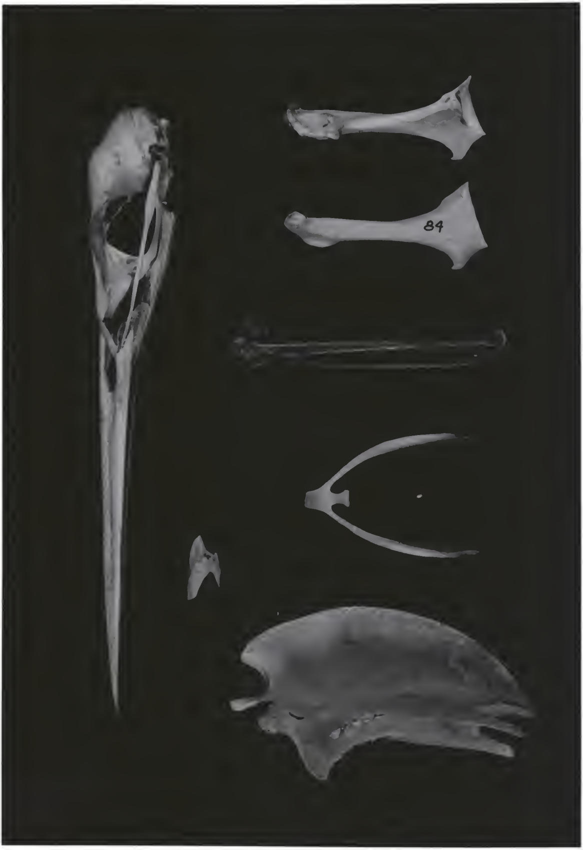
84

Plate 6

Subfamily Ardeinae

Tribe Nycticoraces

Nycticorax nycticorax

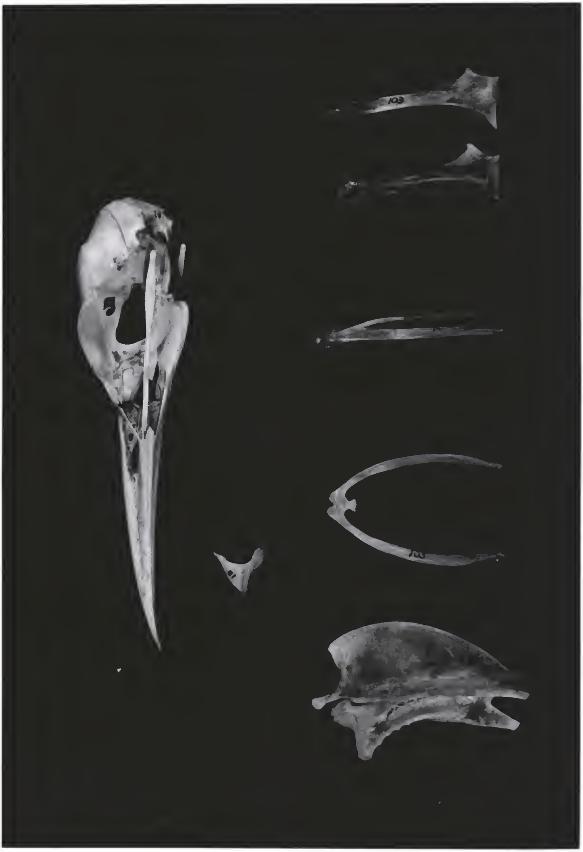
103
103

Plate 7

Subfamily Ardeinae

Tribe Tigriornithes

Tigrisoma lineatum

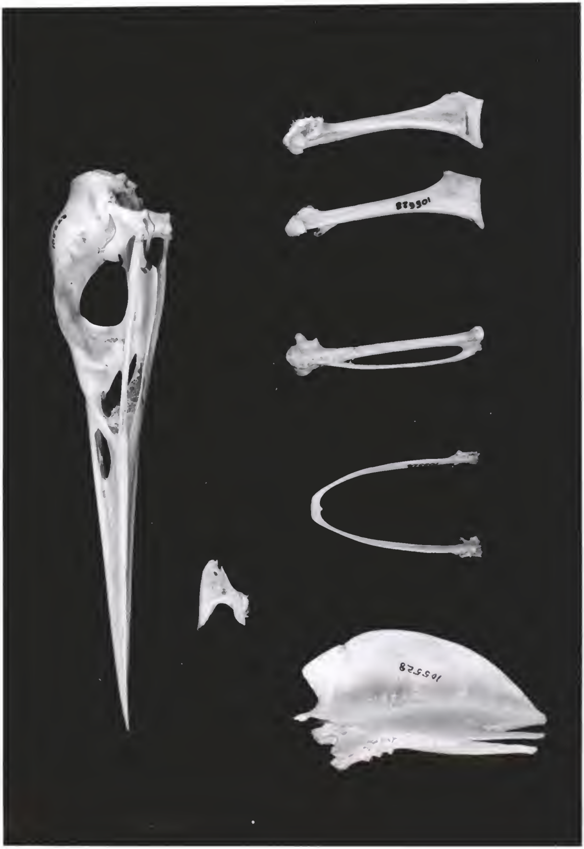
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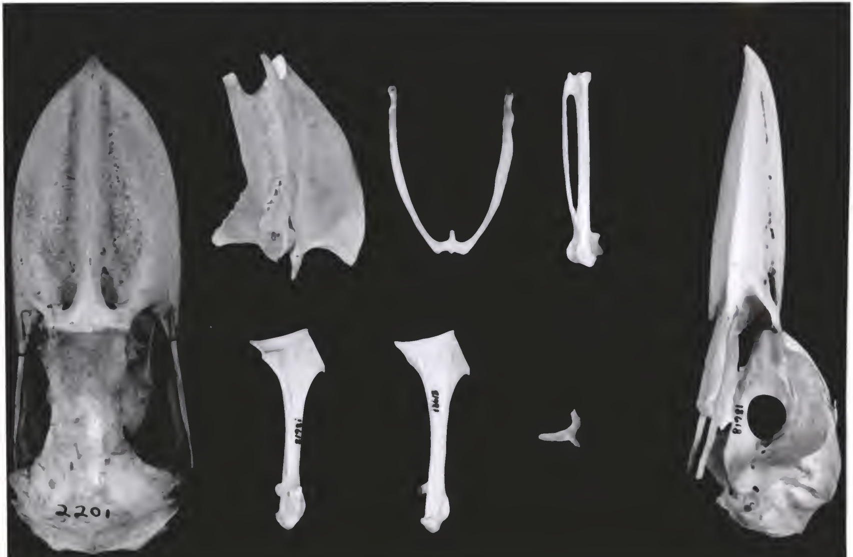
Plate 8

Subfamily Cochleariinae

Cochlearius cochlearius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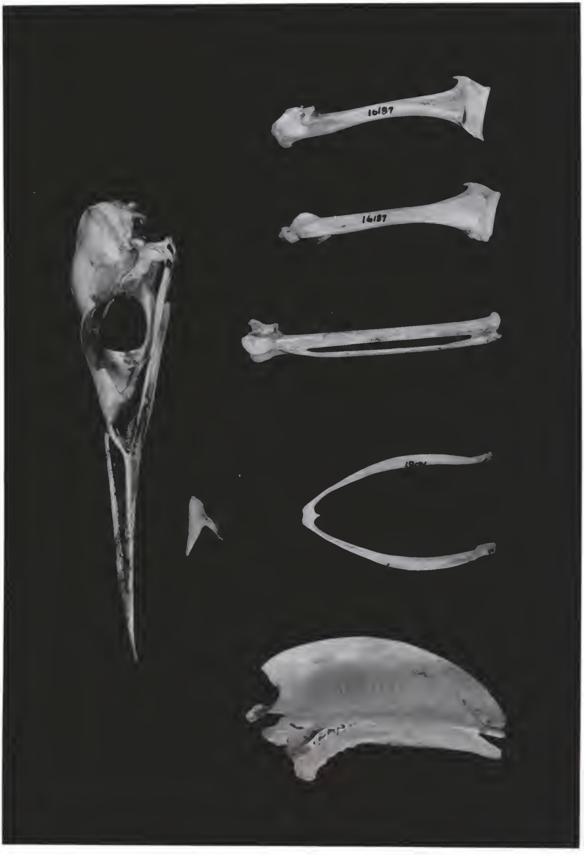
18618
81981
18618

Plate 9

Subfamily Botaurinae

Botaurus stellaris


16187
16187

BIOGRAPHICAL SKETCH

Claude T. Adams, Sr., was born April 29, 1919, in Pavo, Georgia. After graduation from Ft. Lauderdale High School, Ft. Lauderdale, Florida, he served six years active duty with the United States Army. At the close of World War II he entered Emory University, Emory University, Georgia, where he received the degree Bachelor of Science in the spring of 1949. He began his graduate studies at the University of Florida in June 1950, and received the degree Master of Science in June 1952. He was employed by the United States Department of Interior from January 1952 to February 1954, as a biologist. He began his work for the degree Doctor of Philosophy in September 1952. He is a member of Phi Sigma Biological Society, Cooper Ornithological Club, the American Ornithologist's Union, and the Society of the Sigma Xi.

This dissertation was prepared under the direction of the chairman of the candidate's supervisory committee and has been approved by all members of the committee. It was submitted to the Dean of the College of Arts and Sciences and to the Graduate Council and was approved as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

May 21, 1956

C. F. Byers

Dean, College of Arts and Sciences

Dean, Graduate School

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